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TABLE OF CONTENTS

Volume 18, Number 14, July 31, 1964

Category *Page*

BIOLOGY AND MEDICINE . . . 3129
General . . . 3129
Ecology . . . 3131
Metabolism, Tissue Distribution, and Toxicology . . . 3132
Radiation Effects . . . 3138
Radiation Effects Therapy and Countermeasures . . . 3157
Radiation Hazards and Protection . . . 3162
Radiotherapy and Radiodiagnosis . . . 3162

CHEMISTRY . . . 3164
General . . . 3164
Analytical Procedures . . . 3164
Inorganic and Physical Chemistry . . . 3168
Organic Chemistry . . . 3185
Radiation Chemistry and Radiochemistry . . . 3187
Separation Processes and Procedures . . . 3199

ENGINEERING . . . 3208
General . . . 3208
Applications of Nuclear Explosions . . . 3209
Facilities and Equipment . . . 3209
Heat Transfer and Fluid Flow . . . 3210
Materials Testing . . . 3213

GEOLOGY AND MINERALOGY . . . 3214
General . . . 3214
Natural Radioactivity and Fallout . . . 3215
Site Survey and Selection . . . 3216
Techniques and Equipment . . . 3216
Thorium and Uranium Minerals . . . 3217

HEALTH AND SAFETY . . . 3218

INSTRUMENTATION . . . 3223
General . . . 3223
Radiation Detection . . . 3227

ISOTOPE TECHNOLOGY . . . 3248
General . . . 3248
Industrial Applications . . . 3248
Power Application . . . 3248
Separation and Production . . . 3248

MATHEMATICS AND COMPUTERS . . . 3250

Category *Page*

METALS, CERAMICS, AND OTHER MATERIALS . . . 3251
General . . . 3251
Corrosion . . . 3253
Fabrication . . . 3255
Properties and Structure . . . 3258
Radiation Effects . . . 3267

METEOROLOGY . . . 3272

PHYSICS . . . 3273
General . . . 3273
Accelerators . . . 3275
Astrophysics and Cosmology . . . 3278
Atomic Physics . . . 3282
Cosmic Radiation . . . 3285
Criticality Studies . . . 3288
Direct Energy Conversion . . . 3288
Elementary Particles and Radiations . . . 3291
Field Theory and Quantum Mechanics . . . 3303
Geophysics . . . 3305
Low Temperature Physics . . . 3309
Neutron Physics . . . 3311
Nuclear Properties and Reactions . . . 3313
Plasma Physics and Thermonuclear Processes . . . 3333
Shielding . . . 3340

REACTOR TECHNOLOGY . . . 3342
General . . . 3342
Auxiliaries and Components . . . 3344
Criticality Studies . . . 3347
Fuels . . . 3348
Power and Power-Breeder Reactors . . . 3351
Production Reactors . . . 3360
Propulsion and Space . . . 3360
Research and Test Reactors . . . 3362

WASTE DISPOSAL AND PROCESSING . . . 3366

GENERAL AND MISCELLANEOUS . . . 3368

CORPORATE AUTHOR INDEX . . . INDEX-1

PERSONAL AUTHOR INDEX . . . INDEX-13

SUBJECT INDEX . . . INDEX-57

REPORT NUMBER INDEX . . . INDEX-145

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Volume 18, Number 14, July 31, 1964

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Volume 18, Number 14

July 31, 1964

NUCLEAR SCIENCE ABSTRACTS

BIOLOGY AND MEDICINE

General

23161 (ANL-6823) BIOLOGICAL AND MEDICAL RESEARCH DIVISION SEMIANNUAL REPORT, JANUARY THROUGH JUNE 1963. (Argonne National Lab., Ill.). Jan. 1964. Contract W-31-109-eng-38. 205p.

Progress is reported for twenty-seven projects. Separate abstracts were prepared for 25. One report appears in NSA as 18:110. (H.M.G.)

For abstracts of individual sections see: 23162, 23163, 23164, 23184, 23185, 23186, 23187, 23188, 23189, 23190, 23191, 23192, 23193, 23194, 23195, 23196, 23197, 23198, 23229, 23230, 23231, 23232, 23233, 23350, and 23351.

23162 (ANL-6823(p.174-7)) EXPERIMENTS WITH HEAVY METAL COMPOUNDS AS FIXATIVES FOR ELECTRON MICROSCOPY. Edward W. Daniels and Norman A. Frigerio (Argonne National Lab., Ill.).

Compounds of Pt, Ir, Hg, and I were tested as fixatives for electron microscopy of Amoeba proteus. None of these solutions was sufficiently toxic to kill the amoebae within 15 min. Therefore RuO_4 was used, and found to be very rapid. Fixative qualities of Os tetroxide are compared with those of RuO_4. (H.M.G.)

23163 (ANL-6823(p.178-88)) PATTERNS OF SEGREGATION OF STRUCTURAL ELEMENTS DURING CELL DIVISION. Charles F. Ehret, Nancy Savage, and Judy Alblinger (Argonne National Lab., Ill.).

In order to characterize certain properties of organelles of the cell surface in Paramecium several new experimental protocols for the study of organelle ontogeny and techniques for ultrastructural autoradiography were devised. The preliminary experiments indicate the validity of these methods. Properties of interest include molecular stability and composition of organelles, generation time of organelles arising from preorganelles, patterns of distribution of new organelles within preexisting organelle complexes and organelle systems, patterns of segregation of old organelles amongst progeny cells following cell division, and, ultimately, longevity of individual cell organelles. (auth)

23164 (ANL-6823(p.189-90)) PRECISION TRIMMER OF SPECIMEN BLOCKS FOR ULTRAMICROTOMY. Theodore N. Tahmisian (Argonne National Lab., Ill.).

The design of a precision trimmer for ultrathin sectioning, previously done freehand, is discussed. (H.M.G.)

23165 (BNL-854) THE BIOLOGY OF AGING. Howard J. Curtis (Brookhaven National Lab., Upton, N. Y.). Mar. 18, 1964. Contract AT-30-2-GEN-16. 14p.

Ionizing radiation accelerates the aging process and has been used as a tool to study the biological mechanisms of of aging. Aging is a slow deterioration with time which manifests itself by an increased susceptibility of the organism to all kinds of disease. Of the many theories of aging, the wear and tear theory and the somatic mutation theory seemed most promising. A series of experiments has shown that stress per se is not a factor in aging. A method has been developed for measuring somatic mutations in mice, and it was shown that in all cases tested so far there is a quantitative correlation between aging and the development of somatic mutations. The simple somatic mutation theory of aging must be modified to account for the long delay between the production of a mutation and its effect on shortening life expectancy. This modified theory correlates many phenomena known to be associated with aging. (auth)

23166 (NP-13918) QUARTERLY PROGRESS REPORT NO. 51 [ON RADIOBIOLOGY], APRIL 15, 1964. (Chicago. Univ. Air Force Radiation Lab.). Contract AF41(609)-1693. 130p.

Separate abstracts were prepared for 9 sections of this report covering the development and testing of radioprotective compounds. (C.H.)

For abstracts of individual sections see: 23202, 23241, 23352, 23353, 23354, 23355, 23356, 23357, and 23358.

23167 (STI/DOC/10/25(p.71-98)) THE MARINE BIOLOGICAL PROJECT AT MONACO. (International Atomic Energy Agency, Vienna).

Results are reported from field and laboratory investigations carried out during 1963 on the distribution of fallout fission products in the sea, the chemistry of sea water, the elemental composition of marine organisms, the interrelations of marine organisms within an ecosystem, and the effects of ionizing radiations on marine ecosystems. Data are included from hydrographic and chemical surveys in the Ligurian Sea. (C.H.)

23168 (STI/DOC/10/25(p.99-111)) THE MIDDLE EASTERN REGIONAL RADIOISOTOPE CENTRE FOR THE ARAB COUNTRIES. (International Atomic Energy Agency, Vienna).

Research activities during 1963 included investigations of hydrology and soil-plant relations in arid and semi-arid regions; applications of tracer techniques to research in tropical medicine; and the radiation control of malaria vector mosquitoes. (C.H.)

23169 (JPRS-24164) REPORTS ON BIOCHEMISTRY FROM THE UKRAINIAN SSR. Translated from Ukr.

Biokhim. Zh., 36: 14-20; 132-55(1964). 32p. (OTS-64-31065)

Three articles are included; separate abstracts were prepared for two. One article on the rupture of disulfide bonds of fibrinogen by cysteine was not included in NSA. (P.C.H.)

For abstracts of individual papers see: 23204 and 23247.

23170 (JPRS-24290) ARTICLES ON BIOLOGY AND BOTANY. Translated from Nauch. Dokl. Vysshei Shkoly, Biol. Nauki, No. 1, 92-8(Jan. 1964). 12p. (OTS-64-31122)

Nine papers are presented. Separate abstracts were prepared for two: the disruption of plant metabolism caused by treating seeds with radioactive substances; and the effect of lime, phosphates, and stable strontium on the accumulation of ^{90}Sr in plants. (H.M.G.)

For abstracts of individual papers see: 23205 and 23206.

23171 GAMMA AND ELECTRON IRRADIATION OF CLAYS AND SOILS. Tsutomu Ojima, Hirokazu Toratani, and Hiroshi Fujimoto. Ann. Rept. Radiation Center Osaka Prefect., 4: 107-11(1963).

The effects of gamma and electron irradiation on clays and soils were investigated. From germination tests it was found that gamma irradiation did not produce any toxic materials for sprouting of seeds. From x-ray diffractometry changes were observed in the relative intensities of basal lines especially for electron-irradiated bentonite. Changes caused by the irradiation for kaolinite were not so much as for bentonite. No effect in the measurement of cation exchange capacity was noted. Values for the energy of activation, which comes from structural water given off at about 680°C, were very large for the irradiated samples as compared to the unirradiated ones. (P.C.H.)

23172 ALTERNATIVE WAYS OF EXPRESSING THE CONCENTRATION FACTORS FOR RADIOACTIVE SUBSTANCES IN AQUATIC ORGANISMS. Ilmo Hela (International Lab. of Marine Radioactivity, Monaco). Bull. Inst. Oceanog., 61: No. 1280, 8p.(Dec. 1963).

Also issued as IAEA Radioactivity in the Sea, Publication No. 6, Dec. 1963.

It is shown that the concentration of radioactive substances in aquatic organisms can be expressed: as the chemical concentration factor; as the concentration factor of a radioisotope (of the same element); as experimental concentration percentage; and as ratio of the accumulated radioactivity to the background ^{40}K radioactivity. (auth)

23173 ^{90}Sr + ^{90}Y BREMSSTRAHLUNG EFFICIENCY IN BONE. R. D. Lloyd, C. W. Mays, and D. R. Atherton (Univ. of Utah, Salt Lake City). Intern. J. Radiation Biol., 7: 339-51(Oct. 1963).

The bremsstrahlung efficiency (x-ray photon output/μC) of beagle bones labeled with ^{90}Sr + ^{90}Y was determined relative to the efficiency in water. The bremsstrahlung counting rate between 50 and 1000 kev from the individual bones was compared to that from a water-filled standard using an 8 × 4 in. NaI(Tl) crystal. Efficiencies were found to vary linearly with both the density and the computed effective atomic number (Z_{eff}) of the fresh, intact bone. The empirical expressions developed from the data, relating relative bremsstrahlung efficiency to Z_{eff} and density were, efficiency = 0.37 + 0.63 (density) and, efficiency = 0.215 + 0.119 (Z_{eff}). For intact beagle bones averaging 1.48 g/cm^3 (Z_{eff} = 9.1), efficiencies were about 1.3 times that of a water-filled phantom. No great effects on efficiency were observed which could be ascribed to uniform versus nonuniform ^{90}Sr labeling or to bone size. (auth)

23174 ON THE PROBLEM OF THE EFFECT OF STAPH INFECTIONS ON PROTEIN CONTENT OF THE BLOOD SERUM OF RABBITS EXPOSED TO IRRADIATION. N. L. Solomin. Sb. Nauchn. [Tr.] Rabot Sverdlovsk. Nauchn.-Issled. Kozhno-Venerol. Inst. Kafedry Kozhno-Venerol. Boleznei, Sverdlovsk. Gos. Med. Inst., No. 4, 197-203(1962).

The effect of experimental Staphylococcus skin infection on the protein content of the blood serum in rabbits that had been subjected to a single irradiation with x rays was investigated. It was noted that Staph-dermatitis against a background of radiation disease produced a dysproteinemia in the animals which was characterized by lowering of the content of albumin, elevation of the content of alpha and beta globulin, and considerable lowering of gamma globulin in the serum. In the opinion of the authors this indicates weakening of protective mechanisms. Propamin and bicillin-3 exerted a favorable effect on the protective properties of the blood serum in the experimental animals. (OTS)

23175 EFFECTS OF IONIZING RADIATION ON THE REPRODUCTIVE SYSTEM. PROCEEDINGS OF AN INTERNATIONAL SYMPOSIUM HELD AT COLORADO STATE UNIVERSITY, FORT COLLINS, COLORADO, [SEPT. 17-19, 1962]. William D. Carlson and F. X. Gassner, eds. Oxford, Pergamon Press, 1964. 478p. £5.

Thirty-four papers were presented. Separate abstracts were prepared for 29, the remainder appear in NSA: 16: 31472; 18: 15891, 15892, 15893, and 15894. (H.M.G.)

For abstracts of individual papers see: 23176, 23177, 23323, 23324, 23325, 23326, 23327, 23328, 23329, 23330, 23331, 23332, 23333, 23334, 23335, 23336, 23337, 23338, 23339, 23340, 23341, 23342, 23343, 23344, 23345, 23346, 23347, 23348, and 23349.

23176 RATE OF SPERMATOGENESIS IN MAN DETERMINED BY INCORPORATING TRITIATED THYMIDINE INTO TESTES. Carl G. Heller (Pacific Northwest Research Foundation, Seattle), Lorna J. Matson, Donald J. Moore, and Yves Clermont. p.263-7 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

Injection of tritiated thymidine directly into the testes of six normal men, who had been vasectomized some years previously, was used to study the rate of spermatogenesis. Radiographic studies were made within one hr after injecting 10 μC tritiated thymidine into the testicular substance, and it was found that the nuclear chromatin of types A and B spermatogonia as well as the pre-leptotene primary spermatocytes was labeled. Testicular biopsies were performed at various later time intervals in an attempt to find the most advanced labeled cell in Stage III that would lead to an estimation of the duration of one cycle. It was confirmed that in man the seminiferous epithelium consists of six distinct cell associations or stages. The duration of each stage was estimated, and it was determined that the duration of one cycle of the germinal epithelium has a duration of 16 days. It was estimated that there are four cycles in man and consequently that the duration of the whole of spermatogenesis is 64 days. Thus, spermatogenesis in man is not unlike that of other mammals. (H.M.G.)

23177 A GENETICAL APPROACH TO THE EFFECTS OF RADIOMIMETIC CHEMICALS ON FERTILITY IN MICE. Bruce M. Cattanach (Inst. of Animal Genetics, Edinburgh). p.415-26 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

Chemicals may induce sterility in laboratory animals by genetical or nongenetical means. Triethylenemelamine (TEM) can cause infertility by both methods. It induces genetical changes in male post-meiotic germ cells that result in embryonic death, and also it interferes destructively with pre-meiotic germ cells. Caffeine, on the other hand, although it reduces male fertility slightly, does not seem to do so by a mutagenic effect on post-meitotic germ cells. So far as nicotine is concerned, the clear lack of a genetical effect in mice may be accepted as evidence that it is not mutagenic—at least in the mouse. However, the complete lack of any sterilizing action either in the male or the female mouse, or even of any deleterious effect on embryonic development, is difficult to reconcile with the sterility obtained by some workers in other laboratory animals. The great variance in results obtained in different laboratories, even with the same species of animal, emphasizes a special difficulty encountered with chemical treatment. Species differences in response to mutagenic and carcinogenic chemicals are well known, but one cannot exclude the possibility of even strain differences. A species difference may apply with CB 1506 whose sterilizing properties in the rat were not repeatable in the mouse. Finally, it is apparent that treatment with chemicals, such as those discussed, could represent a serious genetic hazard to human populations. The use of these drugs for therapeutic purposes undoubtedly outweighs this factor, especially since the genetical effects are principally recovered from post-meiotic germ cells. However, their use for temporary anti-fertility purposes cannot be so easily justified, for the real genetic hazard lies in the probability that, if a chemical can induce genetically based sterility, it will almost certainly be capable of inducing gene-mutations in pre- as well as post-meiotic germ cells. Caffeine, on the other hand, is unlikely to have such deleterious consequences in human populations. Its effect on mouse fertility does not have a genetical basis, and the level of human consumption is too low for a detectable effect on fertility to be expected. Furthermore, the possibility of a genetical effect on human pre-meiotic cells is remote since Lyon was unable to find an increase in the mutation rate following treatment of mouse spermatogonia with caffeine. (auth)

Ecology

23178 (HI-303-RR/A-III) SPECIAL ASPECTS OF ENVIRONMENT RESULTING FROM VARIOUS KINDS OF NUCLEAR WARS. PART II, ANNEX III. APPLICATION OF INPUT-OUTPUT ANALYSIS TO A HOMEOSTATIC ECOSYSTEM. Robert U. Ayres (Hudson Inst., Inc., Croton-on-Hudson, N. Y.). Jan. 8, 1964. Contract OCD-OS-62-218. 28p. (AD-428117)

An input-output approach to the study of perturbed ecosystems is discussed. A mathematical model was devised and applied to an open system consisting of vegetation, plant-feeding invertebrates, predaceous and parasitic invertebrates, and vertebrates. (H.M.G.)

23179 (HI-303-RR/A1-2) SPECIAL ASPECTS OF ENVIRONMENT RESULTING FROM VARIOUS KINDS OF NUCLEAR WARS. PART II, APPENDIX 1-2. HISTORICAL EXAMPLES OF ECOLOGICAL DISASTER. Jean M. Ingersoll (Hudson Inst., Inc., Croton-on-Hudson, N. Y.). Jan. 8, 1964. Contract OCD-OS-62-218. 43p. (AD-433784)

The studies of the giant African snail and the Australian rabbit presented here illustrate the severe problems which can arise from the introduction of animal species to new habitats and the difficulties in finding solutions to these problems; both of these pests have successfully defied attempts to control them, that is, bring them into a more preferred balance with their environment, for more than a hundred years. As these studies show, even when the threat is well defined the solution can be difficult. Definition of postattack ecological threats of this kind has not yet been attempted in a systematic or detailed way. Such analysis and consideration of possible solutions to the problems likely to occur require the efforts of ecologists, entomologists, conservationists, and other relevant professionals. It is hoped that a selective review presenting historic instances of ecological imbalance, of which this report forms a part, may help create a deeper understanding of the potential problems and permit more intelligent decisions to be made with regard to advocating special preparations or ameliorative action. (auth)

23180 (PG-Report-578) THE BIOLOGY OF THE SOLWAY FIRTH IN RELATION TO THE MOVEMENT AND ACCUMULATION OF RADIOACTIVE MATERIALS. XII. LABORATORY INVESTIGATIONS. E. J. Perkins, B. R. H. Williams, and A. Hinde (United Kingdom Atomic Energy Authority. Production Group. Chapelcross Works, Annon, Dumfriesshire, Scotland). 1964. 26p.

Data are presented regarding the marine aquarium and experimental work carried out at Chapelcross. A tank system having no water circulation, but intense aeration by compressor has proved successful. Many organisms were maintained in a healthy condition for long periods, and an experimental food chain has proved possible. Experiments on the feeding rates of Carcinus maenas and Cancer pagurus and the feeding mechanisms of Carcinus maenas are described. (auth)

23181 (UCLA-12-522) INFLUENCES OF A THERMONUCLEAR CRATERING TEST ON CLOSE-IN POPULATIONS OF LIZARDS. Frederick B. Turner and Clayton S. Gist (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). Apr. 1964. Contract AT-04-1-GEN-12. 32p.

Very few adult lizards were observed within 6,000 ft of ground zero during a four-month period following the Sedan explosion of a large thermonuclear device 635 ft underground on July 6, 1962. Sampling in June 1963 indicated that the apparent absence of adults within 4,000 ft was real. Adults of three species were observed between 4,500 and 5,000 ft from ground zero. Absorbed tissue doses, as registered by microdosimeters implanted in lizards before the test and recovered on July 28, were 15% less than free-air doses registered in the area. (C.H.)

23182 ZINC 65 IN EUPHAUSIIDS AS RELATED TO COLUMBIA RIVER WATER OFF THE OREGON COAST. Charles Osterberg, June Pattullo, and William Pearcy (Oregon State Univ., Corvallis). Limnology Oceanog., 9: 249-57(Apr. 1964).

Most of the 65 Zn in the northeast Pacific Ocean originates in the Columbia River as a result of the Hanford, Washington, nuclear reactor operations. The Columbia River is also the principal source of freshwater in the region, so that at certain seasons the plume of the river is detectable far at sea because of its low salinity. In an effort to determine the fate of the river water at sea, euphausiids from the ocean off Oregon were used as biological monitors. ^{65}Zn content of euphausiids was measured by gamma-ray spectrometry, and relations between ^{65}Zn content and salinity distributions over the area were examined. Some correlations were apparent, but deviations occurred. For example, ^{65}Zn levels remained fairly high off Oregon even when Columbia River water was not evident as a low-salinity plume. This indicates that water from the Columbia River, which accumulates as a plume off Oregon in the summer, influences the ^{65}Zn content in animals in the area throughout the year. The long half life of ^{65}Zn in the mixed layer, diurnal migrations of euphausiids, and seasonal reversal of currents all may contribute to the maintenance of this reservoir of ^{65}Zn in the ocean off the Oregon coast. (auth)

23183 A SELECTIVE ENRICHMENT OF THE FISSION PRODUCT ^{137}Cs IN MUSHROOMS. Hans Grueter (Universität, Munster, Ger.). Naturwissenschaften, 51: 161-2 (1964). (In German)

The selective uptake of ^{137}Cs by mushrooms was investigated by gamma spectrometry. Concentrations ranged from 300 to 800 pC for various species. Contents in various parts of the mushrooms were determined. (M.C.G.)

Metabolism, Tissue Distribution, and Toxicology

Refer also to abstract 23833.

23184 (ANL-6823(p.44-75)) TOXICITY AND METABOLISM OF RADIONUCLIDES. V. PROGRESS REPORT FOR PERIOD ENDING JUNE 29, 1963. William P. Norris, Louise S. Lombard, and Carl E. Rehfeld (Argonne National Lab., Ill.).

Lesions observed in beagles of four age groups (5 and 13 months, 4 and 5 yr) are described. Studies were also made on 21 dogs maintained on a synthetic diet. The semisynthetic diet was proved capable of supporting growth and maintaining weight in unselected beagle stock. Unsuccessful attempts were made to identify a urinary reducing substance excreted by dogs after 325 r ^{60}Co gamma irradiation. Techniques for determining free amino acids in the blood of beagles were examined with particular emphasis on proline and hydroxyproline. Results of physical examination of dogs with ^{144}Ce burdens are presented. No one abnormal condition attributable to irradiation is common to all of the dogs. (H.M.G.)

23185 (ANL-6823(p.76-80)) DOSE TO GONADS FROM INJECTED Sr^{90} AND Y^{90}. Austin M. Brues, Harry Auerbach, and Georgia DeRoche (Argonne National Lab., Ill.).

To evaluate the gonadal dose that results from injection of radionuclides, male mice two to four months of age were injected intraperitoneally with 5 μC/g of a carrier-free equilibrium mixture of ^{90}Sr and ^{90}Y. At suitable intervals the mice were sacrificed by bleeding from the heart, and samples of whole blood, testis, and bone were analyzed for radioactivity. Tabulated results indicate that: for the first two or three hours, Y and Sr seem to be cleared from the blood about equally, while after that time, the clearance of Y is somewhat greater; ^{90}Y activity in the testis is subject to extreme variations under the conditions of injection, and throughout the first two days its activity exceeds that of ^{90}Sr; as early as three to four hours, the specific activity of bone (femur) with respect to both nuclides is a factor of 10 or more higher than that of the testis. Observations lead to the conclusion that it is impractical to attempt a precise estimation of gonadal dose in the mouse from intraperitoneally injected ^{90}Sr–^{90}Y. (H.M.G.)

23186 (ANL-6823(p.86-90)) ATTEMPTS AT REDUCTION OF ERYTHROCYTE CATALASE LEVEL. [PART] II. Robert N. Feinstein, John E. Seaholm, and Larry B. Ballonoff (Argonne National Lab., Ill.).

Methods for reducing erythrocyte catalase activity were studied in female CF1 and Charles River mice. Three types of compounds were injected intraperitoneally in combination: glucose oxidase, as a continuing source of H_2O_2 *in situ*; 3-amino-1,2,4-triazole (AT) or 5-mercapto-1,2,3,4-tetrazole, which were shown to be effective inhibitors of liver catalase *in vivo* and of crystalline catalase *in vitro*; and various agents usually considered to react with sulfhydryl groups. Injection of glucose oxidase alone, in sublethal doses, was without effect on blood catalase, but in supralethal doses changes were caused in the catalase activity per ml whole blood. If injection of AT was preceded by injection of lethal doses of glucose oxidase, blood catalase activity was decreased. This represents a genuine inhibition. None of the sulfhydryl reagents tested in combination with AT and glucose oxidase significantly affected the erythrocyte catalase. 5-Mercapto-1,2,3,4-tetrazole was shown to be a significantly more potent catalase inhibitor that was AT, if administered with glucose oxidase-reduced erythrocyte catalase. (H.M.G.)

23187 (ANL-6823(p.91-8)) EFFECT ON CATALASE *IN VIVO* AND *IN VITRO* OF COMPOUNDS RELATED TO AMINOTRIAZOLE. Robert N. Feinstein, John E. Seaholm, and Larry B. Ballonoff (Argonne National Lab., Ill.).

The catalase-inhibiting effect of aminotetrazole-(AT)-related compounds was studied in CF1 female mice six to eight weeks of age. The most effective catalase inhibitor encountered was 5-mercapto-1,2,3,4-tetrazole. In the *in vitro* system it is more effective than AT by two orders of magnitude; *in vivo*, the ratio is about four to one. Only slightly less effective in the *in vitro* system was S-methylisothiosemicarbazide. (H.M.G.)

23188 (ANL-6823(p.102-4)) PROGRESS REPORT: STUDIES ON OSSIFYING CARTILAGE. Klaus E. Kuettner and Arthur Lindenbaum (Argonne National Lab., Ill.).

Physical and biochemical processes involved in the transformation of cartilage into bone are studied. Interest was focused primarily on the mucopolysaccharide-containing portion of collagen. Studies were begun on the ion-binding properties of mucoprotein extracts by ion exchange and titration techniques. Another study attempted to devise a gentle separation and purification procedure for mucoproteins based on selective precipitation with dyes and other complex cationic substances capable of forming macromolecular complexes. (H.M.G.)

23189 (ANL-6823(p.109-10)) PROGRESS REPORT: PLUTONIUM REMOVAL. VIII. CHEMICAL REMOVAL OF MARROW AND ITS ASSOCIATED PLUTONIUM FROM BONE. Joan F. Markley, Marcia W. Rosenthal, and Arthur Lindenbaum (Argonne National Lab., Ill.).

Using the entire tibia as a representative bone a chemical method of marrow Pu separation is presented. The difference in skeletal uptake of monomeric and polymeric Pu indicates the degree to which the deposition of polymeric Pu in the bone is minimized because of reticulo-endothelial uptake. The proportion of Pu associated with the marrow is higher following administration of the polymeric solution. (H.M.G.)

23190 (ANL-6823(p.111-13)) PROGRESS REPORT: PLUTONIUM REMOVAL. IX. AN ULTRAFILTRATION TECHNIQUE FOR ESTIMATING THE COLLOIDAL PROPERTIES OF PLUTONIUM SOLUTIONS. Arthur Lindenbaum, William M. Westfall, Marcia W. Rosenthal, and Joan F. Markley (Argonne National Lab., Ill.).

A method was developed for measuring the colloidal state of Pu by determining the fraction of Pu ultrafilterable through a cellophane membrane after centrifugation. (H.M.G.)

23191 (ANL-6823(p.118-23)) ISOLATION OF CELL COMPONENTS FROM AMOEBA PROTEUS. C. Ward Kischer, Edward W. Daniels, and Anna Kane Laird (Argonne National Lab., Ill.).

Work was directed toward isolating and identifying the constituents of amoebae in the hope that eventually one might be able to produce radiorestoration by injection of such chemically and morphologically defined material. Amoeba proteus cells were homogenized, and cell components were isolated by an arbitrary procedure of centrifugal fractionation. Fractions were studied by both light and electron microscopy. (H.M.G.)

23192 (ANL-6823(p.124-7)) PROGRESS REPORT: SOLUBLE PROTEINS FROM CELL NUCLEI. A. D. Barton (Argonne National Lab., Ill.).

Experiments concerned with the response of soluble nuclear proteins, isolated from rat liver, to changes in the physiological state of the animal are reported. Response to prolonged starvation and recovery, to prolonged administration of a liver carcinogen, and to administration of hydrocortisone were studied. Results were compatible with the hypothesis that some of the nuclear proteins function as adaptor molecules to which inducers can be attached. (H.M.G.)

23193 (ANL-6823(p.128-40)) BIOSYNTHESIS OF METHIONINE IN SACCHAROMYCES CEREVISIAE; PARTIAL PURIFICATION AND PROPERTIES OF S-ADENOSYLMETHIONINE : HOMOCYSTEINE METHYLTRANSFERASE. Stanley K. Shapiro, David A. Yphantis, and Aldona Almenas (Argonne National Lab., Ill.).

The S-adenosylmethionine : homocysteine methyltransferase of Saccharomyces cerevisiae was purified over 500-fold. No cofactors were demonstrated, but participation of a metal is indicated. The general properties of the enzyme are described. The reaction has been shown to involve only the transfer of the methyl group of S-adenosylmethionine to homocysteine, resulting in the products methionine and S-adenosylhomocysteine. (auth)

23194 (ANL-6823(p.141-51)) THE CALCULATION OF ISOTOPE SEPARATION FACTORS OCCURRING IN THE CHROMATOGRAPHY OF DUAL-LABELED COMPOUNDS. Donald W. Simborg and Peter D. Klein (Argonne National Lab., Ill.).

Three equations for the calculation of isotope fractionation values were examined. These are: the probit analysis, which measures the simple displacement of one peak from another; Ln-ϕ, the relation of isotope ratio to the displacement of one peak from another where both dispersions are identical; and MODI-ϕ, the relation of isotope ratio to displacement of one peak from another where the dispersions are different. The MODI-ϕ method of calculation provides the basis for a broader usage of isotope fractionation in the study of the chromatographic process. (auth)

23195 (ANL-6823(p.152-6)) A COMPUTER PROGRAM TO SIMULATE A TWO-COMPONENT CHROMATOGRAM WITH OR WITHOUT CONTAMINANT. Barbara Kunze, Sylvia Tyler, and Merlin H. Dipert (Argonne National Lab., Ill.).

A study of isotope fractionation during chromatography of dual-labeled compounds was greatly expedited by a procedure for constructing synthetic chromatograms from known parameters for the means, standard deviations and numbers of counts, using the assumption that the distributions are Gaussian. The Fortran program was designed for the IBM-1620 to assist in a study of the separation of dual-labeled tritium and carbon materials with and without a contaminant. The program makes it possible to consider two or three overlapping normally distributed populations: to find the number of counts for each component within an interval, and to compute their ratios and the cumulative percentages of total counts for the individual curves. A Fortran listing of the program and a block diagram are given. (auth)

23196 (ANL-6823(p.161-4)) MOLECULAR AND ULTRASTRUCTURAL ASPECTS OF PLASTID DEVELOPMENT AND CHLOROPHYLL PRODUCTION IN THE CHLORELLA MUTANT C-10. Gary W. Bryan and Judy A. Alblinger (Argonne National Lab., Ill.).

An attempt was made to correlate intracellular structural changes with molecular transitions induced by light or Fe in C-10 mutants of Chlorella vulgaris. It appears that mutation has blocked the alga's ability in darkness to produce not only chlorophyll but also its entire photosynthetic apparatus: light is required for the formation of lamellae in C-10 as in higher plants. The intermediate stages for this process in the mutant are being examined. The work done to date indicates that for a comparable quantity of chlorophyll produced, the lamellar development induced by Fe is similar to that induced by illumination. Autoradiographs, observed with the electron microscope, of C-10 exposed to light while suspended in tritiated leucine suggest that chloroplast lamellar proteins are synthesized during this period. (auth)

23197 (ANL-6823(p.169-73)) INTRANUCLEAR STRATIFICATION IN THE AMOEBA, PELOMYXA ILLINOISENSIS. Edward W. Daniels, Evelyn P. Breyer, and C. Ward Kischer (Argonne National Lab., Ill.).

Nucleoplasm stratification by centrifugation was attempted in Pelomyxa illinoisensis. In nuclei centrifuged at 80,000 × for 15 min some stratification was seen, but the boundary between the electron-dense centrifugal layer and the less dense portion was not sharp. Some stratification was seen also in amoebae centrifuged at 133,000 × g for 8 min. Nuclei from amoebae centrifuged at 140,000 × g for 5 min showed a sharp boundary between electron-dense and less dense areas. (H.M.G.)

23198 (ANL-6823(p.191-8)) FURTHER STUDIES ON ACTION SPECTRA AND QUANTUM REQUIREMENTS FOR THE TRIPHOSPHOPYRIDINE NUCLEOTIDE REDUCTION AND THE FORMATION OF ADENOSINE TRIPHOSPHATE BY SPINACH CHLOROPLASTS. Clanton C. Black, Charles A. Fewson, Martin Gibbs, and Solon A. Gordon (Argonne National Lab., Ill.).

With the demonstration that isolated and illuminated chloroplasts were able to evolve oxygen, reduce triphosphopyridine nucleotide and phosphorylate adenosine diphosphate, it became possible to measure the action spectra and quantum requirements for these processes. In an earlier report of this series measurements were described on the action spectra and quantum efficiency spectra for both reduced triphosphopyridine nucleotide (TPNH) and adenosine triphosphate (ATP) formation. The present experiments extend the earlier data and clarify some of the apparently anomalous results previously obtained. The nonlinear response of ATP formation to increasing intensity of illumination, which was previously reported for white light, was found also with monochromatic light. In contrast, the rate of TPNH formation is linear with increasing intensities of either white light or monochromatic light. It is suggested that this difference in kinetics may be caused, at least in part, by adenosine triphosphatase activity. (auth)

23199 (BNL-828) TRACE METALS: ESSENTIAL OR DETRIMENTAL TO LIFE. George C. Cotzias (Brookhaven National Lab., Upton, N. Y.). Apr. 10, 1963. Contract [AT(30-2)-Gen-16]. 17p.

Brookhaven Lecture Series No. 26.

The role of essential trace metals in the maintenance of structural and functional integrity of living organisms is reviewed. The possible role of excesses of trace elements in the etiology of many degenerative diseases of man is postulated. The similarities of Wilson's disease and Parkinson's disease to two forms of manganese poisoning found in man are discussed. Data are included from studies on the distribution of ^{54}Mn in rats and man. Results of preliminary experiments indicate a relation between Mn and the formation and function of melanin granules located in the extrapyramidal system. (C.H.)

23200 (HW-SA-3350) METABOLISM OF SOME SNAP RADIONUCLIDES IN MINIATURE SWINE. R. O. McClellan, L. K. Bustad, and R. F. Keough (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [May 11, 1964]. Contract AT(45-1)-1350. 12p. (CONF-522-1)

From Annual Meeting of the Aerospace Medical Association, Miami, Fla., May 1964.

Data are summarized on the gastrointestinal absorption, metabolism, and body burden of ^{85}Sr titanate, ^{144}Ce, and ^{147}Pm in miniature swine after oral and intravenous administration. The body burden of animals given ^{85}Sr and ^{144}Ce was periodically estimated by whole-body counting, excreta analysis, and radiometric analysis of tissues at 7 to 10 days post administration of radioisotope. The 10-day retention of ^{147}Pm was determined by tissue analysis. The data for ^{144}Ce and ^{147}Pm affirm the present limits for exposure to these radionuclides. Values observed for gastrointestinal absorption of ^{85}Sr titanate were about 50-fold less than those observed in similar animals for $^{90}SrCl_2$. Preliminary data are reviewed from a 6-yr study of over 200 miniature swine maintained for life on a diet containing 6 levels of $^{90}SrCl_2$ ranging from 1 to 3100 μC ^{90}Sr/day. No deleterious effects were observed in animals that had ingested 25 μC ^{90}Sr/day or less for up to 5 yr. Only at levels of 125 μC ^{90}Sr/day and above were deleterious effects observed. It is concluded that if a factor of 50 difference between the uptake of soluble ^{90}Sr and ^{90}Sr titanate is used, an intake of 1250 μC/day of ^{90}Sr titanate would not produce deleterious effects in miniature swine. (C.H.)

23201 (LFEN-N1.11) ESTUDO AUTORADIOGRÁFICO DA INCORPORAÇÃO DA TIMIDINA TRITIADA EM CROMOSOMAS HUMANOS. I. PRIMEIROS ENSAIOS. (Autoradiographic Study of the Incorporation of Tritiated Thymidine in Human Chromosomes. I. First Experiments). A. A. Teixeira Pinto (Portugal. Junta de Energia Nuclear. Laboratório de Física e Engenharia Nucleares, Sacavém). Jan. 30, 1964. 23p.

Advantages and disadvantages of using tritiated thymidine as a tracer in studies of DNA synthesis and chromosome identification in human cells in tissue cultures are discussed. Tissue culture techniques and autoradiographic methods are described. (C.H.)

23202 (NP-13918(p.1-12)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. I. STUDIES ON THE TOXICITY AND MECHANISM OF ACTION OF 2-MERCAPTOETHYLAMINE. Bernard E. Hietbrink and Kei-Ming Yam (Chicago. Univ. Air Force Radiation Lab.).

Experiments were conducted to determine the effect of sodium pentobarbital, hexamethonium bromide, and ergotamine tartrate on the increase in blood glucose levels caused by 2-mercaptoethylamine (MEA) in adult female rats. Results of these experiments showed that 25 mg/kg of pentobarbital prevented the marked increase in blood glucose caused by 200 or 250 mg/kg of MEA. Subcutaneous administration of hexamethonium did not significantly inhibit the marked increase in blood glucose caused by this protective agent. Hexamethonium was somewhat more effective in inhibiting the effect of MEA on blood glucose levels when given intraperitoneally. Subcutaneous or intraperitoneal administration of ergotamine completely prevented the increase in blood glucose levels caused by 200 mg/kg of MEA. Results of studies on the influence of sodium pentobarbital on the acute toxicity of MEA indicated that 25 mg/kg of pentobarbital caused approximately a two fold increase in the LD_{50} value of MEA. Administration of 30 mg/kg of pentobarbital was more effective in preventing MEA induced lethality when given 10 min before than it was when injected five min after the sulfur-containing compound. Preliminary experiments indicated that repeated injections of pentobarbital did not increase its protective effect against MEA toxicity. Atropine sulfate did not antidote the lethal effects of 250 mg/kg of MEA to adult female rats. (auth)

23203 (UR-646) THE DILUTION TEST AS A MEASURE OF RENAL FUNCTION IN NIOBIUM POISONED RATS. William L. Downs and Jonathan H. Harwood, III (Rochester, N. Y. Univ. Atomic Energy Project). Apr. 13, 1964. Contract W-7401-eng-49.

Control, female, albino rats given a water load of 50 ml/kg, excreted 50% of this load as urine within 94 ± 11 minutes ($T_{EU_{50}}$). The administration of a single intraperitoneal dose ranging from 10 to 30 mg Nb/kg resulted in 2- to 4-fold increases in the $T_{EU_{50}}$ value 24 hr after the niobium was injected. When Nb was complexed with ascorbic acid prior to injection, the $T_{EU_{50}}$ value was within control limits. However, rats given a single intraperitoneal dose of Nb and then given 3 doses of ascorbic acid at intervals of 1, 3, and 6 hr showed $T_{EU_{50}}$ values that were not markedly different from those observed in rats given Nb only. Increased $T_{EU_{50}}$ values were observed in rats given single intraperitoneal doses of uranyl nitrate (1.2 to 2.4 mg U/kg), mercuric chloride (2.0 mg Hg/kg), and sodium tripolyphosphate (480 mg/kg). (auth)

23204 (JPRS-24164(p.19-42)) SYNTHESIS AND TRANSFORMATION OF AMINO ACIDS AND OTHER ORGANIC COMPOUNDS BY THE EFFECT OF RADIATION AND OTHER TYPES OF ENERGY. M. A. Kolomiychenko. Translated from Ukr. Biokhim. Zh., 36: 132-55 (1964).

The effects of an integrated flux of uv rays as well as uv rays with wavelengths of 2537 and 3600 Å, of the visible region with a wavelength of 5450 Å, and of infrared rays with a wavelength of 1.5 to 2.5 μ on the synthesis and transformation of amino acids and other organic compounds were investigated. The separation and identification of the amino acids formed in the irradiated mixtures were done by chromatography on ion exchange resins and on paper. The results showed that in a majority of the cases amino acids are synthesized with a greater or smaller number of carbon atoms than in the carbon chain of the organic acid or other predecessor, that is, substrate, taken for the synthesis of the amino acids. The mechanism of the transformation of certain amino acids into others in the process of irradiation of their aqueous solutions is discussed. A brief review on the photochemical synthesis of amino acids and peptides is also included. (P.C.H.)

23205 (JPRS-24290(p.36-42)) ON THE DISRUPTION OF PLANT METABOLISM CAUSED BY TREATING SEEDS WITH RADIOACTIVE SUBSTANCES. G. V. Il'ina, N. N. Kuznetsova, and S. G. Rydkii. Translated from Nauchn. Dokl. Vysshei Shokly, Biol. Nauki, No. 1, 92-5(Jan. 1964).

By radioinduced metabolic disruption in plant seeds, the effect of feeding conditions on change of the disruptions was shown. Wheat seeds growing in a ^{32}P medium were found to undergo a sharp drop in germinating power during the initial period; retarded shoot appearance; decrease in weight; and increase of the sprout protein nitrogen content. A shift in sugar accumulation towards the monosaccharide was also noted in the ^{32}P-treated plants. The strongest disruption in hydrocarbon metabolism in the wheat sprouts caused by the effect of ionizing radiation upon the seeds was manifested in a medium with an increased nitrogen concentration. At the same time, the potassium nitrate and the barium and manganese microelements helped to weaken the disruption in hydrocarbon metabolism caused by the effect of radiation. (H.M.G.)

23206 (JPRS-24290(p.43-7)) ON THE EFFECT OF LIME, PHOSPHATES AND STABLE STRONTIUM ON THE ACCUMULATION OF STRONTIUM-90 IN PLANTS. N. M. Skadchenko. Translated from Nauchn. Dokl. Vysshei Shkoly, Biol. Nauki, No. 1, 96-8(Jan. 1964).

Effects of various doses of stable Sr, lime, and potassium phosphate on ^{90}Sr uptake was studied in oats. The experiments showed that the introduction of various additives into the soil has a basic influence upon the formation of the dry composition and on the harvest of oats. The accumulation of ^{90}Sr was most significantly reduced under the effect of liming. A smaller effect was produced by the liming on the amount of ^{90}Sr picked up in the stalks of oats. Potassium phosphate in high doses reduced the accumulation of ^{90}Sr in the grain, leaves, and stalks. The application of stable Sr in the soil under the conditions of the experiment markedly increased the ^{90}Sr content of the plant. (H.M.G.)

23207 (JPRS-24704(p.6-11)) ACCUMULATION OF I^{131} BY THE SKIN AND HAIRS OF ANIMALS AND MAN. A. Ya. Loshak and A. V. Terman. Translated from Byul. Eksperim. Biol. i Med., 56: 49-52(1963).

Radiometric analysis of skin, kidneys, and thyroid glands of rats at intervals of 15 min to 48 hr after injection of 5 μC ^{131}I showed that the skin accumulated ^{131}I during the first 2 hr after injection and that the quantity dropped gradually during the next two hr. Iodine-131 was stored in fur in low concentrations that increased with time. Observations on six patients who had received therapeutic doses of ^{131}I indicate similar reactions in human skin and hair. (C.H.)

23208 HISTOLOGIC OBSERVATION ON THE TUMOR TISSUE AFFECTED BY FATTY ACIDS FROM THE LIVER OF X-RAY IRRADIATED RABBITS (OX). Michio Yamamoto, Kozo Utsumi, and Satimaru Seno (Okayama Univ., Japan). Acta Med. Okayama, 17: 131-8(1963).

The growth-inhibitory effect of the fatty acids (OX) from the liver of x irradiated rabbits on the solid type of Ehrlich ascites tumors was observed in mice by both gross and histologic observations. OX substance, a fraction of fatty acids extracted from the liver of x irradiated rabbits was actually found to inhibit the tumor growth by local injection, resulting in the disappearance of the tumor after 12 injections during a one-month period, using 2.4 ml of 2.5% emulsion for total dosage. Histologic observations reveal degeneration and necrosis of tumor cells, whereas in the control animals active proliferation of tumor cells was observed. (auth)

23209 POTENTIATION OF CHEMOTHERAPY OF EXPERIMENTAL TUMORS BY DEUTERIUM OXIDE. A. J. Finkel, D. M. Czajka, and J. J. Katz (Argonne National Lab., Ill.). Acta Unio Intern. Contra Cancrum, 20: 201-3(1964).

Use of the deuterium isotope effect to control the growth of neoplastic tissues was investigated by combining deuteriation of the organism with chemotherapy. Quantitative investigations of transplanted Krebs-2 tumors, both solid and ascites, confirmed the existence of a potentiating effect for some anti-tumor agents in mice. Thus, injections of 5-fluorouracil, 2 mg/kg on four successive days, was much more effective in controlling Krebs-2 ascites tumors in mice drinking 30% D_2O than nondeuteriated control animals. Similar results were obtained with 6-mercaptopurine. Cyclophosphamide and deuteriation together markedly suppressed Krebs-2 grown as a solid tumor to a greater extent than did the compound or deuterium alone. These observations appear to be a consequence of the considerably altered internal environment resulting from the substantial replacement of hydrogen by deuterium in the tissues. (auth)

23210 EFFECT OF Cs^{137} AND Sr^{90} ON THE GROWTH AND REPRODUCTION OF MICE. [PART] II. Kazuo Nishio and Tsuneo Megumi. Ann. Rept. Radiation Center Osaka Prefect., 4: 115-17(1963).

NA-2 strain mice were administered water contaminated with ^{137}Cs and ^{90}Sr, and data on the mortality and reproductive function were recorded. Preliminary data on the tolerance of the mice against transplanted Ehrlich ascites tumors are included. The mice were divided into four groups: Group I was fed water containing 0.4 μC of ^{137}Cs and 0.1 μC of ^{90}Sr per ml; Groups II and III were fed water containing $^{1}/_{10}$ and $^{1}/_{100}$, respectively of the nuclides; and Group IV was used as controls. Half of 28 mice had died by 185 days after birth and all mice by 420 days in the 1st generation of I. The second and third generations of II and III showed slower gradient of survival curves than that of IV. The 2nd generation of group I were only 5 mice (all female). Litters of first birth, however, were observed to be a little more in the 1st generation of groups II and III than group IV. Only one mouse showed tolerance against tumor inoculation exceptionally among 53 inoculated animals and it belonged to the 3rd generation of group III and to the case of continuous isotope administration after inoculation. (P.C.H.)

23211 TRITIUM-HYDROGEN EXCHANGE IN KERATINS. S. J. Leach, Julie Hill, and L. A. Holt (Commonwealth Scientific and Industrial Research Organization Melbourne). Biochemistry, 3: 737-43(May 1964).

The rate of exchange of keratin fibers with tritiated water was investigated under various conditions. There is a large equilibrium-isotope effect in the sense that tritium enrichment in the fiber phase appears to be greater than that in the solution phase by a factor of 1.28. There are four classes of exchangeable H atoms in keratin, distinguishable by their ease of exchange. In addition to rapidly exchanging H atoms, there are slower ones that show a pH dependence characteristic for structures which are stabilized by protonated side chains. A third class of H atoms exchanges only at elevated temperatures with a diffuse temperature dependence suggestive of structures such as α helices of various thermal stabilities. Before the fourth class of hydrogens can be exchanged, the keratin must be disrupted by drastic treatments with alkali or LiBr or certain reducing agents. The structures involved here are probably the stable multiple helices which are characteristic of many structural proteins. This interpretation of the rate data should permit use of the hydrogen-exchange technique for following the conformational changes in keratins and other structural proteins, which occur as a result of chemical treatment or mechanical deformation. (auth)

23212 STRONTIUM-90 IN MARINE ORGANISMS DURING THE PERIOD 1957-1961. Rinnosuke Fukai, Hamaji Suzuki, and Kazuko Watanabe (Tokai Regional Fisheries Research Lab., Tokyo). Bull. Inst. Oceanog., No. 1251, 16p.(Nov. 14, 1962).

Also issued as IAEA Radioactivity in the Sea, Publication No. 1, Nov. 14, 1962.

Various marine organisms collected during the period from 1957 to the summer of 1961 were analyzed for ^{90}Sr. The scheme of analytical procedures was described together with the check data on the procedures involved. The ^{90}Sr content of marine organisms in terms of Sr unit was generally lower in marine organisms than that in terrestrial organisms during the period of the study. ^{90}Sr content of marine organisms varies in the same group of the organisms from one species to another and also in the same species depending on the date and place of collection. It was different in different parts of the body. Some organisms collected from depths more than 1,000 m in 1959 contained ^{90}Sr, suggesting the transport of ^{90}Sr from the surface to the deep layer. In spite of relatively wide variations of stable Sr content among various species of marine organisms, the ratios of Sr to Ca by weight are fairly constant within the same group of marine organisms. The Sr/Ca ratio obtained suggests the relative discrimination of Sr to Ca by marine organisms in their metabolic processes. (auth)

23213 1,6-DIPHOSPHOALDOLASE FRUCTOSE ACTIVITY IN THE KIDNEY OF THE MOUSE DURING EXPERIMENTAL INTOXICATION WITH URANYL NITRATE. Anny Alibert, Pierre Bastide, and Gaston Dastugue (Faculté Mixte de Médecine et de Pharmacie, Clermont-Ferrand, France). Compt. Rend. Soc. Biol., 157: 2217-19(1963). (In French)

The 1,6-diphosphoaldolase fructose activity in the kidney of white mice that had received an intraperitoneal injection of uranyl nitrate solution was determined at periods of 24, 48, 72, and 96 hrs after injection. The results were tabulated and show that the enzyme activity was lowered in the kidney homogenates. (J.S.R.)

23214 THE MICROSTRUCTURAL MODIFICATIONS OBSERVED IN THE RENAL TUBES OF MICE TREATED WITH URANYL NITRATE. P. Stoebner, Y. Cussac, A. Porte, and A. Batzenschlager (Faculte de Medecine, Strasbourg). Compt. Rend. Soc. Biol., 157: 2301-4(1963). (In French)

The ultrastructure of the lesions produced in mice kidney cells by different doses of uranyl nitrate (3, 24, and 48 mg/kg) was studied. The results show that the speed and massiveness of the necrotic lesions depend on the dose administered. The osmotic troubles are expressed by swelling of the cells, and protein resorption was affected. The degenerative processes are shown by profound alterations of the cytoplasmic structures. The processes of tubular reparation occur at the same time as necrosis. It is shown that some of the ultrastructural modifications of the renal cells seem to be due less to a local toxic effect than to a general perturbation of the ion exchange and an alteration of the circulating proteins. The swelling of the cells and the formation, in the cytoplasm, of vesicular agglomerates can also be observed in the normal kidney in some segments of proximal tubes. The resorption of uranium salts was observed only after injection of high doses and generally in uninjured cells. The phenomena of regeneration appeared very early. (J.S.R.)

23215 STUDIES ON THE RADIOBIOLOGICAL EFFECT OF ^{3}H-THYMIDINE ON THE DNA TURNOVER IN LANDSCHUETZ ASCITES TUMOUR CELLS. G. Zajicek and J. Gross (Hebrew Univ., Jerusalem). Exptl. Cell Res., 34: 138-43(Mar. 1964).

The radiobiological effect of tritiated thymidine (^{3}H-TDR) in Landschütz ascites tumor cells from mice was investigated. The cells were incubated in vitro with ^{3}H-TDR. The utilization of ^{3}H-TDR at various time intervals and after various levels of radioactivity was analyzed by the addition of a second dose of ^{3}H-TDR and analysis of the incubation mixture for labeled nucleic acid and labeled precursor pool. Increasing the dose of ^{3}H-TDR above the level of 0.7 μC/10^{6} cells resulted in a decreased uptake of ^{3}H-TDR by the cells. The inhibition of the uptake was proportional to the radioactivity of the ^{3}H-TDR in the initial dose. It was also observed that the ^{3}H-TDR caused a breakdown of DNA with the appearance of its label in the precursor pool. This effect increased with the time of exposure to the first radiation dose. It is activated only by the second ^{3}H-TDR dose. This effect is explained by the activation of nucleases. (auth)

23216 THE EFFECT OF A Ca-RICH DIET ON THE RETENTION OF RADIOSTRONTIUM BY RATS DURING LACTATION. W. E. Kollmer and H. Kriegel (Heiligenberg-Institut, Ger.). Intern. J. Radiation Biol., 7: 333-8(Oct. 1963). (In German)

During lactation the favored removal site of the alkali earth metals in rats was the femur. Disappearance of bone minerals was not diminished in the mother by a Ca-rich diet during lactation. This diet causes an additional removal of ^{90}Sr from the mother animal and the young. The reduction of radioactivity from the mother and young after a Ca-rich diet explains a lower ^{90}Sr/Ca ratio in the blood in comparison to normal nourishment of the mother. (auth-tr)

23217 THE USE OF LANTHANUM TO STUDY THE DEGRADATION OF A PROTEINPOLYSACCHARIDE FROM CARTILAGE. Paul T. Doganges and Maxwell Schubert (New York Univ., New York). J. Biol. Chem., 239: 1498-1503(May 1964).

A method using La is described to separate the native compound of protein and chondroitin sulfate (PP-L) from the form of chondroitin sulfate (CS(Alk)) made by alkaline degradation of PP-L. This method of separation makes it possible to follow quantitatively the time course of the breakdown of PP-L in NaOH (0.15 M, 25°). The reaction is complete in 2 hr and only slight changes in the products occur in the next 14 hr. The major product of this reaction, CS(Alk), is not precipitated from cold aqueous solution by La, and it contains 2% hexose, 1% sialate, and 5% peptide. Chondroitin sulfate made by trypsin digestion of PP-L, CS(Tryp-2), differs sharply from CS(Alk) in chain weight and precipitability with La, although these two forms of chondroitin sulfate scarcely differ from each other analytically. (H.M.G.)

23218 THE DISTRIBUTION OF THE I^{131} IN THE THYROID GLAND MEASURED BY MEANS OF MULTI-FIELD METHOD. Jan. Doroszewski, Henryk Kowalski, Tadeusz Majle, and Marcin Krotkiewski. Polski Przeglad Radiol. i Med. Nuklearnej, 28: 175-83(1964). (In Polish)

The introduction of the scintigraphic method led to a neglection of the multi-field method. Values of the multi-field method in diagnostic procedures are demonstrated. The multi-field method is based upon the measurements of the ^{131}I activity in several fields over the thyroid gland. The activity is measured by means of a scintillating counter with a narrow collimation. The results of model measurements where the distribution of ^{131}I is imitated in certain experimental variations are discussed. The measurements of the ^{131}I activity in experimental conditions demonstrate that the method permits the detection of a hot area if its diameter exceeds 9 mm and cold area when it has a diameter larger than 15 mm. The exact technique is presented (the mean dose of ^{131}I is 5 μC), and the results are compared with those of the scintigraphic method. (auth)

23219 EFFECT OF ϵ-AMINOCAPROIC ACID ON DEPOSITION OF RADIOIODINATED FIBRINOGEN AND ANTIBODIES TO FIBRINOGEN IN TURPENTINE-INDUCED ABSCESSES OF THE RAT. Letitia E. Mutschler (Univ. of Rochester, N. Y.). Proc. Soc. Exptl. Biol. Med., 115: 1024-8(Apr. 1964).

An investigation of the effect of orally administered 5% ϵ-aminocaproic acid (EACA) in drinking water on the behavior of intravenously injected ^{131}I-fibrinogen and ^{131}I-antibody to fibrinogen was carried out in both normal rats and rats with abscesses produced by subcutaneous injection of turpentine. Treatment with EACA had no demonstrable effect on either whole-body retention or blood half life of either ^{131}I-fibrinogen or ^{131}I-antibody in normal rats. The most striking effect of EACA was to decrease greatly the rate of removal of ^{131}I from the abscess area. Six days after injection of ^{131}I-fibrinogen, 11% of the injected ^{131}I was still present in single abscesses of EACA treated rats while in non-EACA treated rats the ^{131}I retained was less than 1% of the injected dose. Similarly, 6 days after injection of ^{131}I-antibody 20% of the injected ^{131}I was present in abscesses of EACA treated animals and only 4% in abscesses of rats not receiving EACA. In animals with two abscesses, the amount of ^{131}I deposited was greater but not double the amount deposited in single abscesses. This evidence supports the hypothesis that EACA is a potent inhibitor of fibrinolysis *in vivo*, as well as *in vitro*. (auth)

23220 EFFECT OF TETRACYCLINE ON RETENTION OF CALCIUM AND STRONTIUM IN RODENTS. Norman S. MacDonald, Kenneth H. Isben, and Marshall R. Urist (Univ. of California, Los Angeles). Proc. Soc. Exptl. Biol. Med., 115: 1125-8(Apr. 1964).

Tetracycline (TC) administered repeatedly in doses totaling as much as 1200 mg/kg body weight, by either the intramuscular or intraperitoneal route, had no significant effect on the body retention of either ^{47}Ca or ^{85}Sr injected into mice or rats. Nor were the amounts of these radionuclides found in the bones reduced by such treatment. Oxytetracycline (OTC) was shown to have a greater chemical affinity for Ca ions than for Sr ions *in vitro*. Repeated large doses of OTC in the toxic range stunted the growth of young rats and caused pathological changes in bone tissue resembling those observed in hyperparathyroidism. Although TC and OTC in large amounts can alter the normal metabolic interrelations between Ca ions and bone tissue, they have no significant value as agents for reducing a potentially hazardous body or skeletal burden of radiostrontium. (auth)

23221 DISTRIBUTION AND RETENTION OF PLUTONIUM-239 AND NEPTUNIUM-237 IN THE RAT ADRENAL. J. E. Ballou (General Electric Co., Richland, Wash.). Radiation Res., 22: 81-94(May 1964). (HW-SA-3153)

The deposition of Pu and Np in the adrenal cortex is characterized by discrete zonal concentrations of the radionuclides in areas of the zona glomerulosa and zona reticularis. Localized deposition in these areas is apparent by the third day postinjection and appears to be more pronounced at later time intervals. Although prolonged retention of the radioelements in the adrenal may be explained in part by the phagocytic capacity of the organ, a significant fraction of the deposition appears to be nonphagocytized, associated with the adrenal parenchyma. If one assumes a rapid turnover of adrenal tissue containing Pu and Np, the slow biological turnover from these sites suggests metabolic reutilization of biological components containing these radioelements. Estimated local radiation doses to the portion of the adrenal containing the majority of Pu or Np are about five times as high as the average adrenal dose. (auth)

23222 EXTRACTION OF THE RADIORESISTANT FACTOR OF *MICROCOCCUS RADIODURANS*. A. K. Bruce (State Univ. of New York, Buffalo). Radiation Res., 22: 155-64(May 1964).

Extracts from the radioresistant bacterium *Micrococcus radiodurans* and the relatively radiosensitive bacterium *Sarcina lutea* were prepared and tested for radioprotective action by using *Escherichia coli* B/r. That prepared from *S. lutea* sensitized the test *E. coli*, increasing in magnitude with concentration. The extract of *M. radiodurans* showed a two-component response: sensitizing at low concentration, and protecting the test organism from radiation effects at high concentration. The experiments demonstrate that a protective compound is synthesized by the cell, and estimates of the quantity present indicate a sufficient amount to explain the high radioresistance of *M. radiodurans*. The shape of the survival curve is also consistent with such an explanation of radioresistance. (auth)

23223 EXPERIMENTAL STUDIES OF C^{14} UPTAKE BY DEVELOPING SPAWN AND YOUNG OF FRESHWATER FISH. G. V. Fedorova (Leningrad State Univ.). Radiobiologiya, 3: 677-81(1963). (In Russian)

Studies were made of the rate and amount of C^{14} ($CH_3C^{14}OOH$) uptake by spawn and young of freshwater fish. The spawn of alburnum, striped perch, and roach in water contaminated with C^{14} (2×10^{-4} and 2×10^{-5} C/l) take up twice the activity of the water. The young of alburnum, striped perch, and roach from contaminated spawn continued to accumulate C^{14}. The spawn and young of carp are contaminated at a slower rate. Two-week-old non-contaminated alburnum transfered into water with C^{14} (2×10^{-4} C/l) rapidly accumulate the C^{14}. (R.V.J.)

23224 ON THE CALCULATION OF SKELETON ACTIVITY BY THE Sr^{90} CONTENT OF BONES. Z. V. Dubrovina, S. Ya. Zaidman, I. Ya. Panchenko, I. A. Sarapul'tsev, and A. M. Skryabin. Radiobiologiya, 3: 773-7(1963). (In Russian)

Spongy and flat bones exhibited a greater tendency to take up Sr^{90} than tubular bones. The Sr^{90} content per gram of calcium in some bones varies with time and therefore cannot be recommended for skeleton activity calculations. However, the content of Sr^{90} per gram of Ca in a hip bone or shoulder blade is close to that of the whole skeleton and remains almost constant. Thus, calculations of whole skeleton activity can be based on the hip bone or shoulder blade. (R.V.J.)

23225 SIMPLE TECHNIQUE FOR RAPID IODINATION OF HUMAN GROWTH HORMONE (HGH) WITH IODINE-131. G. Lamoureux, G. Rémillard, J. Labarre, and R. Mathieu (Hôpital Notre-Dame, Montreal). Rev. Can. Biol., 23: 21-3(Mar. 1964). (In French)

A fast and simple technique for labeling human growth hormone (HGH) with ^{131}I is presented. The iodination of HGH is performed within a few minutes in the vial containing the ^{131}I and an oxidizing agent. The mixture is then transferred into a resin column presaturated with bovine serum albumin. Between 60 and 70% of HGH-^{131}I is recovered and the labeled hormone does not seem to lose its immunological properties. More than 95% of the radioactivity is precipitated by 10% trichloroacetic acid, while between 75 and 85% is precipitated by the immunological method. (auth)

23226 CALCIUM ABSORPTION IN MAN: BASED ON LARGE VOLUME LIQUID SCINTILLATION COUNTER STUDIES. Leo Lutwak and Jay R. Shapiro (National Inst. of Arthritis and Metabolic Diseases, Bethesda, Md.). Science, 144: 1155-7(May 29, 1964).

A technique was developed for the in vivo measurement of absorption of Ca in man after oral administration of 1 to 5 μC of ^{47}Ca and continuous counting of the radiation in the subject's arm with a large volume liquid scintillation counter. The maximum value for the arm counting technique is proportional to the absorption of tracer as measured by direct stool analysis. The rate of uptake by the arm is lower in subjects with either the malabsorption syndrome or hypoparathyroidism. The administration of vitamin D increases both the absorption rate and the maximum amount of Ca absorbed. (auth)

23227 THE EFFECT OF SOIL MOISTURE AND RUBIDIUM CONCENTRATION ON DIFFUSION AND UPTAKE OF RUBIDIUM-86. Gerald A. Place and Stanley A. Barber (Purdue Univ., Lafayette, Ind.). Soil Sci. Soc. Am. Proc., 28: 239-43(Mar.-Apr. 1964).

An autoradiographic technique was used to study the effect of soil moisture and Rb concentration on ^{86}Rb diffusion and uptake by corn plants. Changes in soil moisture influenced the rate of diffusion, rate of root elongation, and the incidence of root hairs. The self-diffusion of ^{86}Rb was linearly correlated ($R^2 = 0.89$) positively with soil moisture, Rb concentration, and interaction of these two factors. The correlation of ^{86}Rb uptake from the soil was positively correlated with ^{86}Rb diffusion values approximated from measurements made of the depleted areas about the roots. When the root diameter used in the calculation included the length of the root hairs, the r^2 was 0.70 and when the root hairs were not included the r^2 was 0.56. The correlation of uptake with the values of Dp/b from self-diffusion studies gave an r^2 of 0.99. Uptake by roots without root hairs was linearly correlated ($r^2 = 0.98$) with soil moisture, Rb concentration, and their interaction. Since the uptake relationships were similar whether or not the roots possessed root hairs, it was concluded that moisture's effect on rate of diffusion was of greater significance in its effect on ^{86}Rb uptake than was its effect on root hair incidence in these experiments. (auth)

23228 A CASE OF BERYLLIUM POISONING. P. A. Voytovich and V. A. Tatorenko. Sudebno-Med. Ekspertiza, [Min. Zdravookhr. SSSR], 6: No. 4, 45-7(Oct.-Dec. 1963).

In 1956 a 31-yr-old man began working daily in contact with Be in powdered or liquid form. In 1957, on routine examination, there was noted a mild leukopenia and lymphocytosis, and myocardiodystrophy. In early February 1958, he returned to the clinic complaining of shooting pain in the right side, dry cough, and a temperature of 37.5°C. The diagnoses were: acute dry right side pleurisy, pleural pneumonia, renal colic, and lung infarct. There was moderate leukocytosis and lymphopenia. The urine contained 0.0463% albumin, a few erythrocytes, and cylinders. Despite treatment the patient died at the end of February. Post mortem examination revealed heart of length 13.5 cm, width 13.5 cm, thickness 5 cm, weight 370 g, hemispheroid form, flattening out on the table; spleen length 13 cm, width 10 cm, thickness 4 cm, weight 295 g; and liver length 28 cm, width 21 cm, thickness 7.5 cm, weight 1860 g. The data obtained did not categorically prove a correlation between formation of thromboembolus in the lung artery and the action of Be. However, considering the marked pathological changes in the lungs and internal organs, the cause of which appeared to be Be poisoning, it was postulated that thrombosis of the intrapulmonary arteries and thromboembolus in the pulmonary artery appeared following toxic action of compounds of this element. (OTS)

Radiation Effects

23229 (ANL-6823(p.5-14)) SOME EFFECTS OF Co^{60} GAMMA RADIATION ON CHICK EMBRYOS. Darryl L. Hessel and S. Phyllis Stearner (Argonne National Lab., Ill.).

The effects of ^{60}Co gamma radiation on the gross morphology of chick embryos was studied, and the sensitivity of these embryos to doses of ^{60}Co gamma was determined by measuring 24-hr mortality. Fertile white leghorn eggs were exposed to a 5000-C ^{60}Co source for doses varying from 500 to over 1700 r. Examination of the eggs at regular intervals after irradiation was carried out by candling or by serial sacrifice. Study of radiation mortality involved 507 controls and 3108 irradiated embryos. Graphs were constructed and the $LD_{50/24\text{-hr}}$ values were estimated through the use of probit transformation. Least square lines for the probit points were calculated by computer. Data from 286 additional controls and 1526 additionally irradiated embryos were included in the study of gross morphological changes due to radiation damage. Radiosensitivity increased sharply between 2 and 9 days, decreased gradually to 15 days, and rose again in the 17-day embryos. Death occurring during the first day after irradiation was characterized by a general circulatory breakdown. An examination of the 2- and 3-day embryos revealed that rate of development was severely decreased in irradiated individuals in proportion to the amount of radiation received. Embryos of all ages that died during the period from 2 to 5 days after irradiation showed inhibited growth and development and severe edema of body tissues and extraembryonic membranes. The only embryos observed more than 5 days after irradiation were those exposed at 3 or 4 days of incubation. At hatching these individuals showed severe edema, dwarfing, and severe malformation of the limbs and, in some cases, the mandible. It was concluded that the increasing radiosensitivity of the chick embryo as it progresses from 3 to 9 days of incubation was correlated with increasing size and complexity of the organism. (H.M.G.)

23230 (ANL-6823(p.15-19)) FRACTIONATED IRRADIATION OF MICE WITH FISSION NEUTRONS AND Co^{60} GAMMA RAYS. Howard H. Vogel, Jr., and Donn L. Jordan (Argonne National Lab., Ill.).

Female CF1 mice were exposed to either fission neutrons or ^{60}Co gamma rays in the gamma-neutron radiation chamber at CP-5. Doses based on an assumed RBE of three amounted to 780 rads fission neutrons or 2340 rads gamma rays given in either one, three, or six fractions per week for 13 weeks. Protraction of neutron or gamma-ray exposure over a 13-week period did not appear to raise the n/r RBE significantly above the figure reported for single exposures. It was further concluded that fractionation of the weekly neutron dose, under the conditions of this experiment, into one, three, or six fractions had no significant effect on the mean survival times of the irradiated mice. Thymic tumors were observed in almost every mouse following the fractionated exposures, but there was no significant difference in the incidence of these tumors between the neutron- and the gamma-irradiated mice. (H.M.G.)

23231 (ANL-6823(p.20-43)) PARAMETERS OF RADIATION DOSAGE THAT INFLUENCE THE PRODUCTION OF OSTEOGENIC SARCOMAS IN MICE. Miriam P. Finkel, Patricia B. Jinkins, and Birute O. Biskis (Argonne National Lab., Ill.).

A single injection of ^{90}Sr produced more osteogenic sarcomas in female mice than the same total amount given in five fractions, and five fractions were more carcinogenic than 20. These results are explained on the basis of the temporal distribution of the absorbed dose. Approximately 36% of the osteogenic sarcomas produced by a single intravenous injection of ^{90}Sr may have been due to the high dose rate during the first week after injection. A single injection of ^{45}Ca produced fewer osteogenic sarcomas than the same total amount given in 5 or 20 fractions, and 5 fractions were more carcinogenic than 20. These results are explained on the basis of both the temporal and spatial distribution of the absorbed dose. Continuous exposure to dietary ^{90}Sr from the time of conception resulted in the production of osteogenic sarcomas when the food contained 5 or more μC ^{90}Sr/g Ca. The body burden of the mice on the 5 μC food reached 0.8 μC when they were 100 days old, and there was very little increase thereafter. Death with tumors occurred later when the level of dietary ^{90}Sr was lower. Male mice on the 15-μC food had only 1/4 as many osteogenic sarcomas as their female littermates. Mice placed on dietary ^{90}Sr when they were about 150 days old had an increased incidence of osteogenic sarcomas when the food contained 15 μC ^{90}Sr/g calcium. Their ^{90}Sr content was about 0.75 μC 100 days after they started on the diet, and it continued to increase slowly. An ^{90}Y body burden was maintained between 70% and 100% of 1.0, 0.5, or 0.25 μC/g for 5 days by a series of repeated injections. Malignant bone tumors have appeared at each level. The average time between roentgenographic recognition of the ^{90}Y-induced tumors and death of the host is much longer than is the case with ^{90}Sr-induced tumors. Exposure of the hind legs of mice to 1000, 625, and 250 r of x-rays produced a few osteogenic sarcomas. The preliminary results suggest a linear relation between dose and response in this dosage range in contrast to the results with injected bone-seeking radionuclides. (auth)

23232 (ANL-6823(p.81-5)) EFFECTS OF PLUTONIUM INJECTED SUBCUTANEOUSLY IN THE RAT AND MOUSE. Austin M. Brues, Harry Auerbach, and Georgia DeRoche (Argonne National Lab., Ill.).

Plutonium, injected subcutaneously in WPF and SD rats, produced malignant tumors at the injection site and also in the skeleton. Subcutaneous injection in CF No. 1 and C57 BL mice yielded malignant tumors in the skeleton, but no locally induced malignant tumors were found in 60 animals so injected. The solubility of the Pu solution and its transport to bone may have decreased the total possible production of malignancies at the injection site. An experiment to verify this, by the use of particulate or colloidal Pu suspensions, is in progress. (auth)

23233 (ANL-6823(p.157-60)) EFFECT OF X-RADIATION ON OXIDATIVE PHOSPHORYLATION IN RAT LIVER MITOCHONDRIA. John F. Thomson and Linda F. Bordner (Argonne National Lab., Ill.).

Liver homogenates were prepared from Holtzman female rats, two to four months old, for observation of rat liver mitochondria with α-ketoglutarate and fumarate as substrates. Four mitochondrial preparations differing in size and homogeneity were prepared by means of density-gradient centrifugation. Only marginal effects of radiation were noted. (H.M.G.)

23234 (EUR-591.d) DIE URSACHEN DER STRAHLENBEDINGTEN AUSSCHEIDUNG VON β-AMINOISOBUTTERSÄURE UND CREATIN. (The Causes of Excretion of β-Aminoisobutyric Acid and Creatine After Irradiation). G. B. Gerber (Centre d'Étude de l'Énergie Nucléaire, Mol, Belgium). 1964. 14p. (CONF-508-1)

From 4th Union of German Doctors for Radiation Protection, Wurzburg, Germany, Oct. 1963.

Creatine and β-aminoisobutyric acid (2-methyl-β-alanine) are excreted in increased quantities into the urine of rats after irradiation. The integral excretion of creatine during the initial four days after exposure increases linearly with the dose up to about 600 r x radiation. Excess creatine in the urine is the result of a diminished uptake of creatine by the muscle. This alteration is also present in the nonirradiated muscle of irradiated animals and, thus, represents an abscopal effect of radiation. It is, however, not mediated by the hormones of the adrenal glands. Excretion of β-aminoisobutyric acid is related to the altered metabolism of DNA. Destruction of cells contributes most of the β-aminoisobutyric acid during the first day after irradiation whereas inhibition of DNA synthesis becomes predominant during the following days. (auth)

23235 (FSU-2690-15) STUDIES IN THE USE OF IONIZING RADIATIONS AS NOXIOUS STIMULI. (Florida State Univ., Tallahassee. Inst. of Molecular Biophysics and Florida State Univ., Tallahassee). May 1, 1964. Contract [AT(40-1)-2690]. 78p.

Separate abstracts were prepared for 5 papers. Three papers covering other aspects of the use of ionizing radiations as noxious stimuli were abstracted previously and appeared in NSA as 17: 23162; 18: 13497; and 18: 19667. (C.H.)

For abstracts of individual papers see: 23236, 23237, 23238, 23239, and 23240.

23236 (FSU-2690-15(Paper 2)) THE EFFECTS OF ATROPINE SULFATE AND PHYSOSTIGMINE ON THE CONDITIONED AVERSION TO SACCHARIN SOLUTION WITH X-RAYS AS THE UNCONDITIONED STIMULUS. James C. Smith and Dale D. Morris (Florida State Univ., Tallahassee and Florida State Univ., Tallahassee. Inst. of Molecular Biophysics). 18p.

Conditioned aversion of rats to saccharin liquid was obtained by using a single pairing of the solution with x-ray exposure. It was found that subcutaneous injections of atropine sulfate have no effect on conditioning the aversion, but large physostigmine doses facilitate the conditioning. (auth)

23237 (FSU-2690-15(Paper 3)) CONDITIONED AVERSION TO SACCHARIN SOLUTION USING SOFT X-RAYS AS

THE UNCONDITIONED STIMULUS. James C. Smith and Dale D. Morris (Florida State Univ., Tallahassee *and* Florida State Univ., Tallahassee. Inst. of Molecular Biophysics). 9p.

Conditioned aversion of rats to saccharin using x rays of different energies and different air doses was investigated. It was found that the higher the dose the greater the aversion and that the aversion was also related to the energy. It was postulated that the difference in response to energy was probably the result of a difference in dose received by the gastrointestinal tract. (auth)

23238 (FSU-2690-15(Paper 4)) A DEMONSTRATION OF CONDITIONED AVERSION TO SACCHARIN SOLUTION USING X-RAYS PRODUCED BY A 3 Mev VAN DE GRAAFF ELECTRON ACCELERATOR. James C. Smith and Dale D. Morris (Florida State Univ., Tallahassee *and* Florida State Univ., Tallahassee. Inst. of Molecular Biophysics). 6p.

Conditioned aversion to saccharin solution by rats was demonstrated using x rays generated by a 3-Mev accelerator as the noxious stimulus. A whole-body dose of 100 r could be given in either three minutes or 12 sec to obtain the effect. The slower rate appears to be more effective in showing the aversion. (auth)

23239 (FSU-2690-15(Paper 5)) CONDITIONED AVERSION TO SACCHARIN SOLUTION USING HIGH DOSE RATES OF X-RAYS AS THE UNCONDITIONED STIMULUS. James C. Smith, Dale D. Morris, and Jean Hendricks (Florida State Univ., Tallahassee *and* Florida State Univ., Tallahassee. Inst. of Molecular Biophysics). 7p.

Conditioned aversion to saccharin fluid was demonstrated in rats using a single 100-r exposure of x rays as the aversive stimulus. Dose rates of 100, 200, 400, and 828 r/min were equally effective in conditioning the aversion in different groups of animals. (auth)

23240 (FSU-2690-15(Paper 7)) FURTHER STUDIES OF CONDITIONED AVERSION TO SACCHARIN INDUCED DURING THE POST EXPOSURE PERIOD. James C. Smith, Dale D. Morris, and Jean Hendricks (Florida State Univ., Tallahassee *and* Florida State Univ., Tallahassee. Inst. of Molecular Biophysics). 7p.

Conditioned aversion of rats to saccharin fluid was demonstrated to persist as long as 2 hr after exposure to a 100-r whole-body dose of x radiation. When the presentation of saccharin was delayed as long as 4 hr after exposure, the irradiated animals did not differ from controls. (C.H.)

23241 (NP-13918(p.13-27)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. II. INFLUENCE OF X-IRRADIATION ON THE DEVELOPMENT OF A THIOPHOSPHATE-OXIDIZING ENZYME SYSTEM IN THE LIVERS OF RATS. Bernard E. Hietbrink and Marjorie Keshmiri (Chicago. Univ. Air Force Radiation Lab.).

Additional studies were undertaken to obtain information on the mechanisms involved in the inhibitory effect of x radiation on the development and maintenance of phosphorothioate-oxidizing enzyme activity in the livers of rats. The influence of injection of certain steroids isolated from the adrenal cortex on the development of this enzyme system in the livers of irradiated young male rats was studied. The results of these experiments indicated that daily administration of 5 mg/kg of desoxycorticosterone acetate did not significantly affect the inhibition of the development of the drug-metabolizing enzyme caused by 200 r of x ray given to the head area. It was found that daily injections of 2 mg/kg of hydrocortisone acetate prevented the inhibitory effect of 200 r to the head on the development of this enzyme in the livers of young male rats. Administration of 0.1 ml/day of adrenal cortex extract caused a substantial increase in the phosphorothioate-oxidizing enzyme activity of the livers of orchiectomized rats. However, additional studies are necessary to determine whether this increase is caused by the androgenic substances contained in the extract or in a result of the stimulatory effect of other nonandrogenic steroids. Measurements of the effect of ionizing radiations on the phenobarbital-induced stimulation of the phosphorothioate-oxidizing enzyme in the livers of young female rats demonstrated that 200 r of total-body x ray does not inhibit the stimulation of enzyme activity induced by 5 mg/kg of this hypnotic agent. Administration of 1 mg/kg/day of guthion caused a slight increase in the development of the phosphorothioate-oxidizing enzyme in young male rats after one week but the activity after 16 daily injections was similar to that exhibited by the 40-day-old controls. Experiments on the influence of repeated exposures of the heads of adult male rats to 400 r of x ray on the activity of the phosphorothioate-oxidizing enzyme in the liver indicated that two to four weekly doses of radiation did not reduce the activity of this drug-metabolizing enzyme. (auth)

23242 (TID-20379) THE EFFECT OF IRRADIATION ON THE MORPHOLOGICAL AND BIOCHEMICAL CHANGES ACCOMPANYING PHAGOCYTOSIS BY LEUKOCYTIC CELLS. Progress Report, June 1963—March 1964. (Saint Margaret's Hospital, Boston). Contract AT(30-1)-3240. 17p.

Metabolic activities of polymorphonuclear leukocytes in exudates induced by casein injection in guinea pigs were studied at various times after exposure of the animals to doses of x radiation ranging from 50 to 1500 r. Oxygen uptake, glucose-1-^{14}C, glucose-6-^{14}C, succinate-1-4-^{14}C, and formate-^{14}C oxidations and lactate production were measured. Alterations in metabolic activities of phagocytizing cells were not noted until 3 days post irradiation and signs of recovery from radiation injury were noted 23 days post irradiation. Data indicate that changes in the metabolic activity induced by irradiation were related to time. Irradiated cells also exhibited a lowered capacity for the phagocytosis of inert particles. No noticeable effects of irradiation were noted in metabolic or phagocytic activities of similar cells irradiated *in vitro*. It was concluded that the radiation effect was indirect in these cells. (C.H.)

23243 (UR-642) THE RETENTION OF STRONTIUM-90 IN THE RATS AS INFLUENCED BY DOSE, AGE AND ADMINISTRATION ROUTE. L. W. Tuttle, R. C. Baxter, B. J. Hopkins, and G. W. Casarett (Rochester, N. Y. Univ. Atomic Energy Project). May 5, 1964. Contract W-7401-eng-49. 23p.

The fractional retention of ^{90}Sr was measured in a total of 460 rats following a series of doses, 71 to 789 μC, administered either orally, intravenously, or intraperitoneally to animals that ranged in age from 40 to 470 days at time of treatment. Fractional retention was shown to be independent of the total dose within the range of 71 to 142 μC in rats that were 6 weeks old at treatment, and 252 to 789 μC in rats that were mature (124 days) at the time of treatment. The fraction of the total dose that was retained at a given time after ingestion of ^{90}Sr decreased as the age of the animal at time of ingestion increased between the ages 40 and 346 days, but no further decrease was observed for treatment after 1 yr of age. The value of the slope of the line representing retention vs. time in log-log plots of the data increased with age at treatment to 1 yr of age beyond which no further increase was noted. Fractional retention was also found to be 5 to 6 times greater at day 15 post-treatment in animals of uniform age given intravenous or intraperitoneal injections as compared to those given the isotope orally. The slope values of the retention curves were similar regardless of administration route for the portion of the curve between the 10th day after the end of the dosage regimen and the terminal observation day. (auth)

23244 (UR-643) GROSS DEVELOPMENTAL ANOMALIES INDUCED BY STRONTIUM-90 IN THE RAT EMBRYO. B. J. Hopkins and G. W. Casarett (Rochester, N. Y Univ.). Mar. 20, 1964. Contract W-7401-eng-49. 27p.

Gross localized developmental anomalies and generalized stunting were observed in rat fetuses on the 20th post-conception day following the intravenous injection of 191 or 382 μC of ^{90}Sr into dams on day 2 or day 10 post-conception. Injection on day 2 post-conception produced significant general stunting in 13.2% of a total of 76 fetuses after a dose of 191 μC and in 23.3% of 30 fetuses after a dose of 382 μC, compared to an incidence of 5% in 159 control fetuses examined. Injection on day 10 post-conception produced a significant incidence of various specific localized developmental anomalies in addition to generalized stunting. A total of 17.6% (12/68) and 51.0% (49/96) of the fetuses were anomalous or stunted in the groups that received 191 and 382 μC of ^{90}Sr, respectively, as compared to a 3.1% incidence (5/159) in controls. The most common effects of ^{90}Sr observed were, in decreasing order of frequency, taillessness, retarded growth (generalized stunting), reduced eye volume, skeletal defects, and interscapular depression. The incidence of defective fetuses observed was apparently related to the dose of ^{90}Sr to the dam and to the gestation stage at time of injection. (auth)

23245 (UR-654) ON ADDITION OF MODES OF RADIATION INJURY IN PRODUCING LETHALITY IN DOGS AND RODENTS. Henry A. Blair (Rochester, N. Y. Univ. Atomic Energy Project). May 14, 1964. Contract W-7401-eng-49. 31p.

It is deduced from data in the mouse and rat, on lethal dose protracted in the one-day range, that about two-thirds of the body has a recovery half-time of a few days while the remainder has a recovery half-time of a few hours. The slower division presumably includes the hematologic and the faster division the intestinal modes of injury. These injuries are completely additive in producing lethality as are partial body injuries produced by partial body exposures. It is deduced from data on mixed gamma and neutron exposures that injuries from these radiations add completely in mice. Partial body injuries in the dog are not directly additive. This occurs because the lethal threshold is inversely proportional to the volume in which the injury is contained. For this reason a given amount of injury is more lethal when distributed within the whole body than within a part and, consequently, partial body lethal doses are much higher relative to whole-body lethal dose in dogs than in rodents. The larger mammals including man may resemble the dog in this regard. (auth)

23246 (AERE-Trans-1000) INACTIVATION OF THE APHTHOUS VIRUS BY MEANS OF GAMMA RADIATION. B. Baldelli, A. Begliomini, T. Frescura, and D. Massa. Translated by O. S. Whitston (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.), from "12th National Meeting on Microbiology, Perugia, Oct. 4-7, 1963." 11p.

The effects of γ radiation on aphthous virus cultures in vitro were studied. It was shown that aphthous viruses of type O, A, and C are highly resistant to γ radiation; the inactivation curves plotted for the three types of virus are identical; dry aphthous virus is more resistant to radiation than virus in the liquid state; aphthous virus inactivated by γ radiation does not interfere in vitro with the same type of active virus; and aphthous virus inactivated by radiation retains intact its antigen capacity of complement fixation in the presence of specific hyperimmune antiaphtha serum. (auth)

23247 (JPRS-24164(p.1-8)) INCORPORATION OF RADIOMETHIONINE IN THE PROTEIN FRACTIONS OF BLOOD SERUM UNDER THE EFFECT OF X-RAY IRRADIATION AND THIOPHOSPHAMIDE. I.V. Savitskii and V. G. Zelinskii. Translated from Ukr. Biokhm. Zh., 36: 14-20(1964).

An investigation was made of blood serum proteins of rats and the incorporation of methionine-^{35}S in various fractions of serum proteins under the action of x rays, thiophosphamide and a combination of these factors in the initial period after irradiation. The working procedure was based on a combination of electrophoresis and radioactive indication. X-ray irradiation (600 r) led to a decrease in the level of total protein in the serum and increase in the incorporation of methionine-^{35}S in all fractions of the serum proteins. The administration of thiophosphamide (15 mg/kg) had relatively little effect on the protein picture of the serum and on the incorporation of methionine in the serum proteins. Combination of x-ray irradiation with thiophosphamide led to decrease in the quantity of total protein and in the gamma-globulin content in the serum. Incorporation of methionine in all the protein fractions was higher than in the control, but for the globulin fractions it was somewhat lower than upon irradiation alone. The results obtained confirm the previously expressed position that, under conditions of the combined effect of ionizing radiation and a chemical preparation, the effect of each of these factors on the organism can be intensified or weakened. (auth)

23248 (JPRS-24696) THE EFFECT OF PRELIMINARY ROENTGEN IRRADIATION ON THE SUSCEPTIBILITY OF WHITE MICE TO THE ORNITHOSIS VIRUS, UPON INFECTION WITH AN AEROSOL OF THE VIRUS. O. M. Popova and O. N. Berezina. Translated from Vop. Virusol., 213-16(Mar.-Apr. 1964). 9p. (OTS-64-31299)

The irradiation of white mice before infection with the aerosol of ornithosis virus increased their susceptibility to that virus. The incubation period was reduced by several days, and there was a certain increase in mortality. In the lungs, liver, and spleen of the irradiated animals the virus was preserved for a longer period and at higher titration levels than in nonirradiated controls. (auth)

23249 (JPRS-24704) EFFECTS OF RADIATION SICKNESS. Translated from Byul. Eksperim. Biol. i Med., 56: 36-8; 49-52; 100-3(1963). 20p. (OTS-64-31304)

Separate abstracts were prepared on three sections of this report. (C.H.)

For abstracts of individual sections see: 23207, 23250, and 23360.

23250 (JPRS-24704(p.12-17)) REGENERATION OF THE SCIATIC NERVE IN ACUTE RADIATION SICKNESS. O. N. Bayshtruk and Ya. I. Ryss. Translated from Byul. Eksperim. Biol. i Med., 56: 100-3(1963).

Regeneration of the sciatic nerve in dogs suffering from moderately severe radiation sickness lagged behind that in controls between the 5th and 10th days after injury. Later the processes of regeneration in both groups of animals developed in similar fashion. (C.H.)

23251 (JPRS-24803) COMPARATIVE STUDY OF THE RADIOSENSITIVITY OF GENETICALLY DIFFERENT

STRAINS OF ANIMALS AND THEIR HYBRIDS. I. S. Kurnishkov. Translated from Zh. Obschch. Biol., 25: 141-4 (Mar.-Apr. 1964). 6p. (OTS-64-31349)

The sensitivity of mice of strains C$_3$HA and C$_{57}$ and their F$_1$ hybrids produced by direct and back crossing to massive whole-body x irradiation at a dose of 550 r was studied. The differences in radiosensitivity between the initial strains were highly reliable statistically. Strain C$_{57}$ black was more radioresistant under the experimental conditions used. Comparison of the radiosensitivity of the F$_1$ hybrid generation with that of the parent strains showed that this trait deviates in the hybrids toward a greater radioresistance than that of the strains used for the crosses. The absence of differences in radiosensitivity among the reciprocal hybrids shows that the development of radiosensitivity among the hybrid animals was governed equally by the maternal and paternal organisms. The similarity of the times at which the irradiated animals died in all variants of the experiment indicated the uniformity of the physiological mechanisms of radiation fatality in mice of different genetic strains and in their hybrids. No material differences were detected in the radiosensitivities of males and females at the x-ray dosage used. (auth)

23252 (ORNL-tr-84) INFLUENCE OF FRACTIONATION AND DOSAGE ON THE CYTOLOGICAL EFFECT OF RADIATION. N. V. Luchnik. Translated by A. L. Monks (Oak Ridge National Lab., Tenn.), from Biofizika, 1: 633-6 (1956). 5p.

Inflated seeds and young bean sprouts were given single or fractionated doses of gamma rays at a dosage of 5000 r. Two days after radiation, the rootlet tips were fixated for cytological analysis. The anaphase content possessed by the chromatin bridges or fragmented chromosomes was calculated using auxiliary compounds colorated with acetolacmoid. Radiosensitivity at first sharply increased, then reached a plateau after which it began to decrease. It was obvious that under the effect of the first fraction a process develops in the cells, as a result of which they become for some time more radiosensitive. DNA and RNA contents were also determined. Data did not establish that the radiosensitivity is a direct function of DNA content, but a correlation between the two undoubtedly exists. In summary, it appears that even such a relatively basic process as the formation of chromosome breakdowns is far from simple, and may be related to various other mechanisms. The dosage time distribution may assume quite a different role, depending on the circumstances. During extended or fractionated radiation, an effect, less marked than for a concentrated single radiation, may be observed; the converse is also true. The reverse time factor can be tentatively explained by the fact that the first fraction or the start of an extended irradiation causes the nucleoproteide metabolism, which makes the cell more susceptible to subsequent radiation change. (H.M.G.)

23253 (OTS-61-11326) THE INFLUENCE OF LOW DOSES OF X RAYS ON SOME SPECIES OF HIGHER PLANTS. Helena Birecka, Wieslawa Szymanska, and Angela Sawicka. Translated by Z. Zarebska from Roczniki Nauk Rolniczych, Ser. A, 79: 911-25(1959). 18p.

Results are reviewed from literature reports of a number of studies demonstrating a stimulative influence on plant growth and development after exposure of seeds to low doses of x radiation. When the studies were repeated in maize, beans, peas, and sugar beets it was found that in every case the stimulation induced by irradiation was also induced by soaking the seeds in distilled water. (C.H.)

23254 ELECTRONICALLY PULSED LIGHT SOURCE FOR THE PRODUCTION OF RETINAL BURNS. W. T. Ham, Jr. (Medical College of Virginia, Richmond), R. C. Williams, F. H. Schmidt, W. J. Geeraets, H. A. Mueller, R. S. Ruffin, and DuPont Guerry, III. Am. J. Med. Electron., 2: No. 4, 308-15(Oct.-Dec. 1963).

A method is described for pulsing an Osram XBO 2001 high-pressure Xe lamp electronically. Currents up to 2,150 amp may be passed through the lamp for time durations of a μsec or less. Through utilization of the optical system for light coagulation, first developed by the Zeiss Optical Company, irradiances as high as 53.6 cal/cm^2/sec can be delivered to the cornea. In rabbits, retinal irradiances of 2,867 cal/cm^2/sec were obtained. Pulse durations as short as 175 μsec (including rise and decay time) were used to produce mild lesions on rabbit retinas. The instrument is being used to investigate optical hazards accompanying short pulses of radiant energy similar to those emitted by nuclear weapons exploded at high altitudes. (auth)

23255 GAMMA IRRADIATION OF ONION BULBS TO INHIBIT SPROUTING. Tsutomu Ojima, Shiro Hori, Toshio Kawasaki, Hirokazu Toratani, Akio Ujihara, Hiroshi Fujimoto, Shigeyuki Mori, Shurji Kitoh, and Isao Sekii. Ann. Rept. Radiation Center Osaka Prefect., 4: 112-14(1963).

Senshu-nakakaka onion bulbs were irradiated with ^{60}Co gamma rays at total dosages of 3000, 6000, 9000, 12000, and 15000 r, and on days 57, 86, and 114 after harvest. The sprouting of onion bulbs irradiated on days 57 and 86 after harvest was inhibited completely with all total dosages, but was not inhibited at 114 days after harvest. The loss in weight of irradiated onion bulbs during storage was less than in the unirradiated. (P.C.H.)

23256 STUDIES ON RADIATION-INDUCED LEUKAEMIA IN MICE. 1. THE INDUCTION OF LYMPHOID LEUKAEMIA BY WHOLE-BODY X-IRRADIATION IN RF MICE AND PLASMA LACTIC DEHYDROGENASE IN LEUKAEMIC MICE. Yasuhiko Takamori, Yasuharu Hori, Tsuneo Megumi, Atsuhiko Takeda, and Kazuo Nishio. Ann. Rept. Radiation Center Osaka Prefect., 4: 118-22(1963).

The induction of lymphoid leukemia in RF mice by x radiation and the activity of the plasma lactic dehydrogenase from normal and leukemic mice is reported. Preliminary results obtained by electrophoretic analysis of plasma LDH from leukemic mice are also included. Lymphoid leukemia was developed in 27 out of 133 irradiated mice within 270 days after irradiation. The earliest lymphoid leukemic mouse was detected at 178 days, and the mean latent period in the induction of lymphoid leukemia was 223 days after irradiation. There was no significant correlation between age of mice and leukemic incidence in mice from 5 to 20 weeks of age. The results indicated that the plasma LDH level increased remarkably in the leukemic mice. Plasma LDH activity varied irregularly with individual mouse. The electrophoretic pattern of LDH of tissues of leukemic mice differed from that of the corresponding tissues of normal mice. (P.C.H.)

23257 RELEASE OF SALINE-SOLUBLE DNA AND HISTOLOGICAL CHANGE IN MOUSE SPLEEN AFTER X-IRRADIATION. Atsuhiko Takeda and Yoshihiro Harada (Osaka Univ.). Ann. Rept. Radiation Center Osaka Perfect., 4: 123-5(1963).

Changes in saline-soluble DNA were investigated and corresponding histological observations were made of the mouse spleen after whole-body x irradiation with smaller doses. After irradiation of mice with 50, 150, 500, and 1000 r of x radiation, the DNA content of the spleen was measured in reference to solubility for 0.14 M NaCl and a relative value of protein-free DNA amounted to 1.6% in the nonirradiated controls. The values in all the cases of given doses linearly increased during 4 hr, then decreased slightly. Even in the case of 50 r, protein-free DNA, the progress of pyknosis in damaged lymphocytes was observed. (P.C.H.)

23258 THE EFFECT OF X-RAYS ON ADENOSINETRIPHOSPHATASE ACTIVITY OF MYOSIN. M. Szabolcs, A. Zsindely, and S. Damjanovich (Univ. Medical School, Debrecen, Hungary). Arch. Biochem. Biophys., 105: 447-9(May 1964).

The influence of x rays on myosin ATPase is presented. Extinction of myosin solutions increased proportionally to the controls with the dose of irradiation. In the case of the control sample, maximum absorption was observed at 277.5 mμ, with a minimum at 250 mμ. The absorption maximum of irradiated material was moved gradually to the left by increasing the dose; the minimum slightly to the right. The spectrophotometric curves represent clearly the damage of myosin structure dependent on the dose of x-ray. The results of measuring the ATPase activity of myosin is shown. After irradiation for 1 min the activity increased 18 to 28%; later it was diminished to about one-half by increasing the dose. The treatment of both irradiated and control myosin solutions with p-chloromercuribenzoate (p-CMB) scarcely changed the activity of irradiated samples, which is in contrast to the significant increase in ATPase activity of control myosin solution. The 18 to 28% increase in ATPase activity of myosin solutions is produced by damage of –SH groups that are most sensitive to the influence of x ray. The change of molecular structure produced by x rays may be a factor affecting the enzyme activity in positive and negative directions under these circumstances. (auth)

23259 THE EFFECTS OF X-IRRADIATION ON THE INCORPORATION OF AMINO ACIDS INTO PROTEINS OF NUCLEI FROM RAT THYMUS GLAND. J. A. Smit and L. A. Stocken (Oxford Univ.). Biochem. J., 91: 155-61 (Apr. 1964).

Protein synthesis in nuclei was inhibited by the addition of ATP. Damage to the nuclear structure occurred and the intranuclear thiol content was decreased. Enhanced protein synthesis was caused by reducing agents. Reagents that oxidized or reacted with thiol groups were inhibitory. Irradiation of isolated nuclei inhibited incorporation of amino acids into proteins. Nuclear protein synthesis was stimulated immediately after whole-body x irradiation. Nuclei prepared from adrenalectomized rats reacted differently on irradiation and showed a decreased synthesis. Protein synthesis was inhibited in both instances 2 hr after irradiation. (auth)

23260 A QUANTITATIVE METHOD OF MEASURING THE EFFECTS OF X IRRADIATION ON THE GROWTH AND FUNCTION OF THE RAT THYROID GLAND. J. Crooks, W. R. Greig, A. G. Macgregor, and J. A. R. McIntosh (Univ. of Aberdeen, Eng.). Brit. J. Radiol., 37: 380-4(May 1964).

The increase in weight of the thyroid gland of the rat produced by the administration of 0.1% methylthiouracil (goitrogenic challenge) for periods of one, two, and four weeks, was measured. The inhibitory effect on thyroid growth of x irradiation at a rate of 250 rads/min up to a dose of 1,600 rads was best apparent with a goitrogenic challenge continuing for four weeks after irradiation and allowed a dose-response curve to be constructed. X irradiation in the same dose range did not affect the iodide trapping function of the gland. (auth)

23261 TUMOR INDUCTION WITH ASTATINE-211 IN RATS: CHARACTERIZATION OF PITUITARY TUMORS. Kenjiro Yokoro, Akira Kunii, Jacob Furth, and Patricia W. Durbin (Columbia Univ., New York and Univ. of California, Berkeley). Cancer Res., 24: 683-8(May 1964).

Inbred rats (W/Fu) of both sexes were given thyroid-destructive doses of ^{211}At. A high incidence of pituitary tumors in both males and females so treated (64.7 and 55%, respectively) was observed at 26 months of age. Morphologic observations on the tumor hosts suggested that most, and perhaps all, pituitary tumors in this series were mammo-somatotropic. Transplantation of seven of the pituitary tumors was attempted, five with success. Four were mammo-somatotropic; the fifth is still under study. Although the pathogenesis of induction of pituitary tumors and mammary tumors by ^{211}At was not clearly established, the present and earlier experiments indicate that direct irradiation played a major role in their induction. Thyroid destruction was complete in all rats but, unlike the results in radiothyroidectomized mice (in which pituitary tumors are invariably thyrotropic), all four pituitary tumors analyzed in transplantation studies were mammo-somatotropic. The mammary tumor incidence was 65% in the females and 5.9% in the males at 26 months of age. Mammary tumors were diagnosed somewhat earlier than pituitary tumors. Nevertheless, stimulation by mammotropes probably played a significant role in mammary tumor induction. (auth)

23262 A CYTOGENETIC STUDY OF THE EFFECTS OF X IRRADIATION ON AEDES AEGYPTI. K. S. Rai (Univ. of Notre Dame, Ind.). Caryologia, 16: 595-607(Sept.-Dec. 1963).

Cytogenetic effects of x-rays (500, 1000, 2000, 4000 r) on the NIH strain of Aedes aegupti L. were studied. Larvae were reared under controlled conditions and were irradiated six days after hatching at a time when most were in the early fourth instar. Five to 10 larvae were fixed for cytological examination at intervals of 0, 1½, 6, 12, 18, 36, and 72 hr after irradiation. Mitotic chromosomes were studied from squash preparations of larval brains stained with acetolactic orcein. Mitotic activity was measured in terms of the total number of dividing cells per brain. Initially, x irradiation inhibitied cell division. Mitotic activity was almost completely suppressed 1½ hr after irradiation. After a time (depending on dose used), this effect was replaced by a great increase in mitotic activity. Twelve hr after irradiation, the larvae exposed to 500 and 1000 r showed about twice as many mitotic figures as did the unirradiated material. The increase in mitotic activity at higher doses was less extreme and took longer to occur. Among the chromosomal aberrations noted were deletions, inversions, exchanges, rings, decentrics and anaphase bridges. Explanations for the induction of these aberrations were discussed. A relation existed between the dose received and the developmental stage at which an individual died. The higher the dose, the earlier the death occurred. Furthermore 2000 r or more resulted in almost 100% mortality. Some possible causes of x-ray-induced mortality and changes in fertility were suggested. (auth)

23263 X-RAY INDUCED MUTATIONS OF PHASEOLUS MUNGO L. I. CHLOROPHYLL MUTATIONS. Manas K. Jana (Indian Inst. of Tech., Kharagpur). Caryologia, 16: 685-92(Sept.-Dec. 1963).

The different chlorophyll mutants obtained after x-ray irradiation of Phaseolus mungo included albina, which was completely white, xanthoalba was yellowish white, xantha was yellow, and chlorina was light green in color. All these mutants died at first leaf stage. The variegated and virescent mutants had normal first pair of leaves. The later leaves of variegated and virescent had white and yellow patches over green colour. Both these, variegated and virescent mutants produced fruits and seeds. The chlorophyll mutants were found to be mostly conditioned by single recessive gene. The gene symbols proposed are alb (albina), xalb (xanthoalba), xa (xantha), ch (chlorina), var (variegated) and vir (virescent). (auth)

23264 INTRAVENOUS INJECTIONS OF HOMOGENATES OF GUERIN EPITHELIOMA. VI. IN THE RAT RECEIVING A PRELIMINARY APPLICATION OF X RAYS. J. Driessens, A. Clay, J. Vanlerenberghe, G. Giaux, L. Adenis, and P. Quandalle (Institut de Recherches sur le Cancer, Lille). Compt. Rend. Soc. Biol., 157: 1981-3 (1963). (In French)

The number of metastases resulting from an intravenous injection of homogenates of Guerin epithelioma in Wistar rats is considerably increased by the administration of a whole-body dose of 400 r x radiation before the injection. The augmentation of the metastatic rate is of the same order as that obtained by preliminary splenectomy or by blocking of the reticulo-endothelial system with Trypan blue. (tr-auth)

23265 INVESTIGATIONS ON THE EFFECT OF LOCALIZED X RAYS AT THE LEVEL OF THE BONE MARROW. STUDY OF THE DESTRUCTION AND RESTORATION. André Chevallier, S. Manuel, and D. Chateau (Faculté de Médecine, Strasbourg). Compt. Rend. Soc. Biol., 157: 2061-5(1963). (In French)

The variation of the number of cells of tibia bone marrow in rats exposed to localized x-ray doses of 50, 100, 200, 300, 500, and 1500 r was studied as a function of time through destruction and regeneration. The destruction and regeneration phases are described, and the regularity of the two phases is discussed. The experimental conditions were rigid with all stress avoided and with the scattered radiation reduced to a minimum. Under these conditions there was an almost linear relationship between the total biological phenomenon released by a localized x-ray exposure and the value of this dose. (J.S.R.)

23266 EARLY STRUCTURAL MODIFICATIONS OF CELLS OF THE DUODENUM CAVITY OF THE MOUSE AFTER IRRADIATION WITH X RAYS. J. Hugon, J. R. Maisin, and M. Borgers (CEEN, Mol, Belg.). Compt. Rend. Soc. Biol., 157: 2109-11(1963). (In French)

A microstructural study of the duodenum cavity of adult mice after whole-body irradiation of 1350 r showed alterations in the mitochondria of the absorbing cells after 30 min. Some microvilli began to dilate after 60 min. The nuclei were enlarged and became irregular after 60 to 90 min. Numerous complex vesicles (cytosomes) appeared in the cells after 3 hrs. They were allied with figures of pycnosis and karyorrhexis. After the sixth hour an intercellular edema dissociated the plasmic membranes. (tr-auth)

23267 EFFECT OF CORTISONE ON GASTRIC LESIONS PRODUCED BY IRRADIATION WITH WEAKLY ULCERIGENIC DOSES. J. Haot (Université, Liege). Compt. Rend. Soc. Biol., 157: 2120-2(1963). (In French)

In order to determine the effect of cortisone on the formation of gastric lesions, adult rabbits were exposed to a single dose of 1250 r x radiation and received from the time of exposure a daily injection of cortisone. A second group received cortisone from the time of the appearance of lesions or from the 15th day. The results showed that a cortisone treatment inhibited the formation of ulcers when it was instituted before the appearance of the lesions. On the contrary, it aggravated their development and favored perforation when it was administered after the development of lesions. These results confirm those obtained with the utilization of a higher x-ray dose. A cortisone treatment instituted after the 15th day did not augment significantly the number of ulcers. It does not, therefore, appear that cortisone favors the transformation of superficial erosions into true ulcers. In the nonirradiated animals, cortisone did not produce the slightest alteration of the gastric mucous membrane and did not seem to have a true ulcerigenic effect in the rabbit. (tr-auth)

23268 DATE ON EXPERIMENTAL, RADIATION-INDUCED CATARACT IN FROGS. V. A. Golichenkov, V. V. Popov, and E. B. Vsevolodov (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 154: 1458-61(Feb. 21, 1964). (In Russian)

Cataract changes in the frog can be observed 3 to 7 days after irradiation with a minimum x-ray dose of 500 r to the head and eyes of the frog. The surface of the eye was scored to accelerate the radiation damage. With a maximum dose of 10,000 to 15,000 r, jagged cataracts could be observed 0.5 to 2 hours after the irradiation. Extensive studies were carried on during the various seasons. Frogs irradiated during the winter hibernation period show no radiation damage to the lens, even though the frogs died as a result of the irradiation. Histological studies of frogs irradiated during spring and autumn showed drastic cataract changes 7 to 12 days after the irradiation. The absence of mitotic activity in the front epithelium explains the seasonal variation in the radiosensitivity of the frog lens. The pathological changes in the frog lens led to early and severe damage of the epithelium. The radiation damage to the eye was accelerated, if the eye was slightly wounded first by physical means. (TTT)

23269 THE STABILITY OF FUNCTIONALLY INHOMOGENEOUS SECTIONS OF DNA WITH RESPECT TO IONIZING RADIATION. G. E. Fradkin (Inst. of Biophysics, Ministry of Health, USSR). Dokl. Akad. Nauk SSSR, 155: 457-60(Mar. 11, 1964). (In Russian)

The invariant and degenerate character of the genetic code makes the code supple and insensitive to small disturbances. However, the code determining protein synthesis differs from the structural code by the absence of degeneracy. This fact may be the reason for the lesser functional stability of the regulatory mechanism of the genome. These ideas were confirmed by the results of studies of radiosensitivity of the structural and regulatory mechanisms of DNA in the moderate phage λ. The appearance of virulent mutants of the moderate phage λ served as a measure of the radiosensitivity of the regulatory mechanism in the moderate phage λ. The virulent (Vi)-mutants were easily distinguished by their ability to reproduce in lysogenic cultures of *E. coli* K-$12_{(\lambda)}$. Suspensions of λ phage in physiological solution were given ^{60}Co doses of 1.0, 2.5, 5.0, and 10 kr. The yield of virulent mutants from the moderate λ phage increased with increasing radiation dose. The virulent virus particles lost their ability to lyse, but retained their ability to reproduce. It was concluded that the repressor mechanism of the genome, which regulates the transfer of genetic information to correspond with synthetic processes in the cell, is more radiosensitive than the mechanism for the storage of structural information. (TTT)

23270 POSSIBILITIES OF CONTROLLING *CALLOSOBRUCHIS SUBINNOTATUS* PIC (BRUCHIDAE) BY GAMMA

RAYS. Heshamul Huque and Muhammad Allahdad Khan (Radioisotopes and Radiation Lab., Karachi, Pakistan). Food Irradiation, 4: No. 3, A2-7(Jan.-Mar. 1964).

Phaseolus aureus grain was used to culture Callosobruchis subinnotatus. Effects of gamma radiation were studied on eggs, full grown grubs, newly formed pupae, and longevity and fecundity. Results are tabulated, and it is concluded that eggs, grubs, pupae, and adults of Callosobruchis can be controlled successfully with doses of 2.5 to 3, 5, 20, and 5 kr, respectively. (H.M.G.)

23271 STORAGE OF RADIATION STERILISED MEATS IN THE PRESENCE OF ACTIVATED CHARCOAL. D. N. Rhodes (Low Temperature Research Station, Cambridge, Eng.). Food Irradiation, 4: No. 3, A8-9(Jan.-Mar. 1964).

The inclusion of activated charcoal in the commodity package was suggested as a method of reducing the foreign odors and flavors that result from the application of a sterilizing dose of radiation to some meats. The efficiency of the transfer of volatiles from the meat, and hence any benefit of the procedure, would be expected to be facilitated at higher temperatures of storage. Experiments testing this are reported. (auth)

23272 IRRADIATION OF MEAT PRODUCTS. Paul-Ivar E. Hansen (Danish Meat Research Inst., Roskilde, Denmark). Food Irradiation, 4: No. 3, A10-17(Jan.-Mar. 1964).

Work on irradiation preservation has been in progress at the Danish Meat Research Institute since 1957. A number of products were tested. It was concluded that the use of ionizing radiation within the meat industry looks promising in a few cases. Irradiation may be used in combination with heat to preserve canned cured hams, and an irradiation treatment of imported animal feeding stuffs (e.g., meat and bone meal) may be used for the elimination of pathogens. Development of a sterile canned ham by the combination of heat and irradiation is considered, and some of the general problems involved in the irradiation of meat products are pointed out. (auth)

23273 ON THE EFFECT OF HOMOLOGOUS BONE MARROW AND LYMPH NODE CELLS TRANSPLANTATION ON X-RAY-INJURY OF EXPERIMENTAL WOUND HEALING IN MICE. Yasuhide Matsubayashi (Hiroshima Univ.). Hiroshima Igaku, 12: 11-56(Jan.-Feb. 1964). (In Japanese)

Whole-body doses of 300 r x radiation caused incomplete healing of wounds in mice. The period of healing was shortened and there was evidence of marked mesenchymal tissue response when the mice were given intravenous injections of homologous bone marrow and lymph node cells after irradiation. The healing process of wounds was observed to be closely related to hematopoietic activity. Delayed secondary disease was not observed during the 10-week study. (C.H.)

23274 EFFECT OF RADIATION ON CYTOPLASMIC MOVEMENT. Paul-Emile Pilet (Universite, Lausanne, Switzerland). Ind. At., 8: 79-82(1964). (In French)

All living cells have a cytoplasmic movement which may be more or less rapid. The biological activity of the cell can be determined as a function of the velocity of this movement. It is therefore interesting to study the effect of radiation on cytoplasmic movement. It is easily seen that the cytoplasmic movement is slowed down by x rays and γ rays and that it stops altogether if the dose is high enough. The long distance effect of radiation was also established through the analysis of the behavior of undisturbed cells placed in the neighborhood of irradiated cells. (auth)

23275 THE EFFECT OF X-IRRADIATION ON THE OXYTOCIN CONTENT OF THE POSTERIOR PITUITARY GLAND OF THE RAT. S. Natarajan and P. W. Dykes (Univ. of Birmingham, Eng.). Intern. J. Radiation Biol., 7: 315-20(Oct. 1963).

High doses of x radiation were administered to young female rats and localized to the head. The posterior pituitary glands were excised and emulsified, and tested for their content of oxytocin by the rat-uterus method. It was found that 10^4 and 2×10^4 r resulted in a similar increase in the oxytocin content of the gland, and the amount of increase was the same regardless of the time interval after irradiation up to eight days. Arguments are advanced which suggest that the reasons for this increase include both hypothalamic damage and inhibition of release into the blood stream. (auth)

23276 ENHANCEMENT OF RADIATION-INDUCED STERILITY IN INSECTS BY PRETREATMENT IN CO_2 + AIR. Leo E. LaChance (Dept. of Agriculture, Mission, Tex.). Intern. J. Radiation Biol., 7: 321-31(Oct. 1963).

When the pupae of the screw-worm fly (Cochliomyia hominivorax (Coquerel)) are irradiated in an atmosphere of CO_2 + air (50-50 mixture), damage to the reproductive system measured in the adult female is greater than that induced by a similar radiation treatment delivered in air. Doses of γ radiation ranging from 2500 to 5000 r were investigated. In all tests the number of females ovipositing, the number of eggs per fecund female, and the egg hatchability were reduced. For CO_2 to be effective in enhancing radiation damage air must be present, and the pupae must be pretreated in the gas mixture for approximately 45 min. Complete sterility can be induced by a treatment of 4500 r delivered in CO_2 + air, whereas irradiation in air alone requires about 5500 to 6200 r to induce complete sterility. Irradiation in CO_2 + air is more damaging to the reproductive system than irradiation in pure oxygen. (auth)

23277 EFFECTS OF SODIUM AZIDE ON ACTION-POTENTIALS IN ISOLATED X-IRRADIATED NERVE FIBRES. James R. Lott (North Texas State Univ., Denton). Intern. J. Radiation Biol., 7: 353-9(Oct. 1963).

The data presented indicate that effects of Na azide on action-potentials of nerves may be separable from those of x irradiation in terms of both sites and magnitude of action. The discussion is based on two possible modes of action: interference with metabolic processes supplying energy for the production of the action potential, and physical alteration of the nerve membranes. Neither a summated increase nor decrement in the action-potentials was observed upon application of the two agents, Na azide and x irradiation, to isolated ventral caudal nerves of rats. (auth)

23278 EFFECTS OF GAMMA-IRRADIATION ON THE PRIMITIVE GERM-CELLS OF THE PREPUBERTAL BOVINE TESTIS. B. H. Erickson (Univ. of Tennessee, Oak Ridge). Intern. J. Radiation Biol., 7: 361-7(Oct. 1963).

Post-natal male Hereford calves aged 1 to 150 days were exposed to a 200-r whole-body dose of γ rays and castrated at 30, 60, or 210 days after irradiation. The quantitative histological analysis revealed that the primitive bovine germ cell is most radiosensitive during the post-natal period which extends from birth to approximately 70 days old. A lesser sensitivity was apparent at 80 to 105 days, and relatively minor damage was produced from 120 to 150 days post-natal. Changes in germ-cell radiosensitivity were shown to be correlated with quantitative and qualitative alterations within the developing germ-cell population. (auth)

23279 THE EFFECT OF TEMPERATURE DURING IRRADIATION ON THE BROOD-PATTERN OF DOMINANT LETHALS INDUCED IN DROSOPHILA MELANOGASTER SPERM. Hans Wedvik and Oeistein Stroemnaes (Universitet, Oslo). Intern. J. Radiation Biol., 7: 369-75(Oct. 1963).

Four sets of males were exposed for half an hour to either 22, 7, 4, or 0°C and then mated to a new set of five virgin females on each day for 14 days. The first sterile males appeared on day 4 in the series exposed to 22 or 7°C, and the number of sterile males increased at almost the same rate on later days in the two series. In the series exposed to 4 and 0°C, the sterile males appeared already on the second day after exposure and increased on later days with a significantly higher rate than in the two previous series. The highest number of sterile males on each day is found in the series exposed to 0°C. Whether the males have been exposed to 22, 7, 4, or 0°C does not seem to influence the fecundity of the fertile males, or the hatchability of eggs fertilized by sperm from these males. Males exposed to 7°C during irradiation with 1000 r of x rays exhibit a significantly higher frequency of dominant lethals than males irradiated at 22°C for all broods from the first to the seventh day after treatment, but the data for later broods indicate no difference between the two series. (auth)

23280 SURVIVAL OF HeLa CELLS CULTURED IN VITRO AND EXPOSED TO PROTRACTED GAMMA-IRRADIATION. Joel S. Bedford and Eric J. Hall (Univ. of Colorado, Denver). Intern. J. Radiation Biol., 7: 377-83 (Oct. 1963).

Experiments are described in which S_3 HeLa cells were exposed to γ radiation at dose-rates of 9.5 and 19 rad/hr (chronic irradiation). The cell survival, in terms of reproductive integrity, was compared with the same cell line irradiated at 44.9 rad/min (acute irradiation). It was found that while a 'type C' multi-hit curve was necessary to describe the survival of cells irradiated at 44.9 rad/min, a simple exponential function of dose was sufficient to describe the survival at 9.5 and 19 rad/min. (auth)

23281 EFFECTS OF X-RAYS ON FEMALE GERM-CELLS OF DROSOPHILA MELANOGASTER. I. DOMINANT LETHAL MUTATION AND OVIPOSITION IN RELATION TO TREATED STAGE. A. J. Bateman and Ann C. Chandley (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Intern. J. Radiation Biol., 7: 385-94 (Oct. 1963).

The sensitivity in terms of dominant-lethal induction was measured for successive eggs laid by Drosophila melanogaster after irradiation of the female with 1000, 4000, and 6000 rad. Hypersensitivity is found in eggs laid by females aged seven days, during the first 12 hr after irradiation. This is attributed to irradiation of Metaphase I. A lower level of sensitivity is found in eggs laid over the next six days. This is attributed to the irradiation of oöcytes in all stages prior to Metaphase I. Finally, a residual incidence of dominant lethals is observed in eggs laid more than six days after irradiation, which are presumed to have been irradiated as oögonia. Oviposition (rate of egg maturation shows an entirely different radiation response. Four thousand rad produces a slight depression of egg laying during the period of low dominant-lethal production, a more marked depression coinciding with the main production of dominant lethals, and a particularly severe depression on day three after irradiation. The pattern of sensitivity after 6000 rad is the same but more marked. The egg-laying rate more than six days after irradiation is slightly depressed by 4000 rad, and more so with increasing doses until 10,000 rad, when complete sterility is produced. After such a dose the ovarioles are atrophied, without oöcytes or oögonia. (auth)

23282 THE LINEAR DOSE-DEPENDENCE OF RADIATION-INDUCED TRANSLOCATION FREQUENCY IN DROSOPHILA MELANOGASTER AT RELATIVELY LOW X-RADIATION DOSES. H. Traut (Kernforschungszentrum Karlsruhe, Ger.). Intern. J. Radiation Biol., 7: 401-3 (Oct. 1963).

Sperm stored in females of Drosophila melanogaster were irradiated with x-ray doses varying from 0 to 0.5 kr. Translocations between the second and third autosome were scored according to genetic technique. Although under the same experimental conditions the typical increase of translocation frequency was obtained with higher doses (0.5 to 5 kr), the expected linear increase at low doses (0.0 to 0.5 kr) is evident. The statistical test, based on weighted regression analysis, shows no indication of departure from linearity for the dose-range from 0 to 0.5 kr, while there is a high degree of significance for the linear term ($\rho = 10^{-10}$). Practical implications of the results are discussed, and translocation results are compared with previous neutron experiments. (H.M.G.)

23283 EFFECT OF γ RAYS ON THE STERILITY OF THE COTTON MOTH (LAPHYGMA EXIGUA). F. K. Rasulov. Khlopkovodstvo, No. 7, 41-2(1963). (In Russian)

Studies of γ radiation effects on cotton moth (Laphygma Exigua) sterility showed that irradiation with 3000 to 5000 r does not prevent caterpillar development and does not inhibit their breeding. Exposure to 7000, 9000, 10,000, and 11000 r permitted only a small number of caterpillars to reach maturity. Irradiation of male and female cocoons with 3000 r resulted in 36.8% sterility in males, at 5000 r–46%, 7000 r–45%, and 10000 to 11000 r–100%. Complete sterility was evident in females following exposure to 5000 r. The life spans of mature moths from irradiated male cocoons was 4 to 5 days; for nonirradiated, 5 to 6 days. (R.V.J.)

23284 THE POST-NATAL GENESIS OF CEREBELLUM DEFECTS IN X-IRRADIATED HOUSE MICE (MUS MUSCULUS DOMESTICUS RUTTY 1772). R. Schmidt (Universität, Halle/Saale, Ger.). Naturwissenschaften, 51: 162-3(1964). (In German)

The influence of x radiation on brain tissue of mice on the day of birth in a whole-body dose of 800 r was investigated. By the third day after irradiation the development of the cerebellum was largely stopped. The fully developed cerebellum of an irradiated mouse compared in size with that of a 5-to-7-day-old normal mouse. (M.C.G.)

23285 CONTRIBUTION ON THE STUDIES OF THE DISTRIBUTION VOLUME OF SODIUM THIOCYANATE FOR SOME TUMOR BEARERS EXPOSED TO IRRADIATION. I. THE SODIUM THIOCYANATE SPACE IN THE COURSE OF EXPOSURE TO RADIATION. C. Bompiani (Università, Rome), E. Falcetti, and P. G. Paleani-Vettori. Nuntius Radiol., 29: 765-76(Oct. 1963). (In Italian)

The distribution volume of the sodium thiocyanate (or SCN space) during the first phases of the exposure to radiation was examined in patients affected by tumor in different sites of the body, in order to study the behavior of the extracellular fluids. In most patients, nearly 70% of the examined cases, a reduction in the volume of the thiocyanate space was observed. Such a reduction began in the course of the irradiation or in the immediately successive phases, reached its maximum nearly 40 min after the end of it, and returned immediately after towards the basal values. The comparison between the data obtained in the course of a simulated irradiation and those obtained, in the same patients, during an effective irradiation, showed that the observed phenomenon is really linked with factors induced by the exposure to the ionizing radiations. From the radiobiological standpoint appear to be important the features which define the phenomenon, such as the precocious appearance, the transitory character, and the reversibility. The transitory aspect and the reversibility of the reported observations allow to advance the hypothesis that the observed changes are part of a complex of phenomena not necessarily linked with the clinical picture of the x ray disease, although it cannot be excluded that these changes lead to the commonly known manifestations of the general radiation syndrome, through intermediate mechanisms not yet known. (auth)

23286 ISLAND-CELL TUMORS IN IRRADIATED RATS IN PARABIOSIS. S. Warren, R. G. Carlstein, J. Steinke, and R. N. Chute (New England Deaconess Hospital, Boston and Harvard Cancer Commission, Boston). Proc. Soc. Exptl. Biol. Med., 115: 910-12(Apr. 1964). (TID-19794)

The incidence, function, age, and sex distribution of adenomas and carcinomas of the islands of Langerhans were studied in Deac-Slonaker rats. In the course of experiments to determine the effects of a single supralethal dose of radiation on duration of life and incidence of tumors young inbred littermate rats of this strain were parabiosed. The technique was to irradiate one of the pair some weeks after parabiosis and when equilibrium was established between the animals. The right-hand rat received a single supralethal dose of 1000 r of 250-kv x rays. For the study 715 pairs of parabiont rats, were chosen at random, but with life spans of over 200 days after operation or irradiation. One hundred thirteen pairs of these parabiosed animals, approximately equally divided as to sex, were used as controls. Males were strikingly prone to develop pancreatic tumors. The tumors of the islands are usually large enough to be seen grossly (0.4 to 1.2 cm). The appearance of the benign tumors was fairly uniform, and they could be separated morphologically into two types. The first type closely followed the architecture and vascularization of the normal island, notwithstanding the distortion caused by the growth process. The second type more obviously meets the neoplastic criteria of Borst: it shows marked structural variations from the normal pattern, the cell cords are much thicker and longer and the capillary bed is reduced. Two adenomas were extracted for insulin by the acid ethanol procedure, and the supernatant fluid was assayed for insulin content by the rat adipose tissue technique, where oxidation of labeled ^{14}C glucose to $^{14}CO_2$ is the index of activity. The carbohydrate metabolism of a number of pairs was studied, but the results fail to correlate with the presence of adenomas. A series of random, usually terminal, blood sugar determinations in different animals ranged from 68 to 214 mg %. Values tend to agree when repeated in the same animal. The low blood sugar value for animals proved later to have adenomas was also 68, the high 214 mg %. As a working hypothesis the following conjecture is put forward: radiation damages the irradiated rat's pancreas and possibly pituitary as well; the damaged islands are overburdened by the metabolic needs and diabetes develops. (auth)

23287 ACTION OF X RADIATION ON CHARA VULGARIS L. V. THE MODIFICATION OF THE LEUCOPLAST AFTER IRRADIATION. Claude Gillet (Université, Liège). Protoplasma, 56: 637-44(1963). (In French)

Various types of abnormal chloroplasts in the newly formed internodial cells appearing after irradiation of the apical cells of Chara vulgaris were considered. The aleatorical division of the cells with similar abnormalities was undertaken and is described. (tr-auth)

23288 AN OXYGEN-DEPENDENT POSTIRRADIATION RESTORATION OF RHIZOPUS STOLONIFER SPORANGIOSPORES. N. F. Sommer, Min Creasy, R. J. Romani, and E. C. Maxie (Univ. of California, Davis). Radiation Res., 22: 21-8(May 1964).

Inhibition of germination after normally lethal doses of γ radiation resulted in a striking recovery of the colony-forming potential of Rhizopus stolonifer sporangiospores. Germination inhibition was achieved by concentrating the spores into a dense suspension (5.6×10^7/ml) in water. During the postirradiation period, low concentrations of O sufficed, but no recovery occurred in its absence. Recovery in spore suspensions in equilibrium with atmospheres of 1 or 2% approached recovery in a pure O atmosphere. When germination was effectively inhibited, a temperature near optimum for growth favored recovery. (auth)

23289 FURTHER STUDIES OF RADIATION EFFECTS ON THE PROTEINS AND THEIR CONSTITUENTS. Raymond A. Patten and Walter Gordy (Duke Univ., Durham, N. C.). Radiation Res., 22: 29-44(May 1964).

The electron spin resonance (ESR) patterns of γ-irradiated proteins were obtained and compared with those of molecular and mechanical mixtures of their constituent amino acids. As in previous studies, the ESR patterns most often found are those characteristic of glycine and cystine (or cysteine) residues. Evidence is found, however, for free radicals formed from alanine and certain other residues in some of the proteins. Pronounced effects of atmospheric gases and of temperature changes are observed. The ESR patterns of the molecular mixtures of the amino acids are unlike either those of the mechanical mixtures or those of the proteins. (auth)

23290 DELAY OF POSTIRRADIATION TEST FLUIDS: A FACTOR IN SACCHARIN AVOIDANCE BEHAVIOR. William A. McLaurin, Barron B. Scarborough, and John A. Farley (Florida State Univ., Tallahassee). Radiation Res., 22: 45-52(May 1964).

Sixty-four male Sprague-Dawley rats were used as subjects in an investigation to determine the effects of various postirradiation treatments on the saccharin avoidance response. Two major variables, saccharin solution or no fluid prior to x-irradiation exposure, were studied under four 24-hr postirradiation conditions: an immediate choice of tap water and saccharin solution, water, saccharin solution, and fluid deprivation. At the end of the initial posttreatment, all subjects were given a choice situation of water and saccharin solution for 10 posttreatment days. The results of the study indicated that there is no significant difference in the intensity or duration of the postirradiation saccharin avoidance between subjects given no fluid or saccharin solutions as the CS prior to radiation exposure and those given an immediate choice after radiation. The no-fluid subjects given water, or deprived, show little or no evidence of avoidance behavior, whereas the corresponding posttreatment groups given saccharin solution as the CS evidence the avoidance response. No significant difference was found between the no-fluid and saccharin CS groups given saccharin solution for 24 hr after exposure. Both groups avoided saccharin solution on postirradiation trials. The results demonstrated that the previous conflicting observations in respect to avoidance behavior of irradiated control groups were a result of the differing intervals between the cessation of the UCS and presentation of the test solutions. The results are interpreted as additional evidence for the hypothesis that saccharin avoidance conditioning takes place, at least in part, in an association between a disturbed physiological state of the organism, resulting from radiation exposure, and the discriminatory solution in the home cage. (auth)

23291 THE ROLE OF AGE AND X IRRADIATION ON KIDNEY FUNCTION IN THE MOUSE. John Berech, Jr. and Howard J. Curtis (Brookhaven National Lab., Upton, N. Y.). Radiation Res., 22: 95-105(May 1964). (BNL-7336)

Female mouse kidneys show a decline with respect to age in the ability to concentrate the urine during a 24-hr water fast. X irradiation early in life has no measurable long-term effect on this process. Kidney cortex slices of old female mice can concentrate *p*-aminohippuric acid against a concentration gradient equally as well as slices from young mice. There is no loss in this ability by cortex slices from young or old female x-irradiated mice. It is uncertain whether compensatory renal hypertrophy after unilateral nephrectomy declines with age in nonirradiated mice. X irradiation does cause a reduction in the degree of compensatory renal hypertrophy in the aging mouse. This reduction may represent a loss in the ability of kidney cells to undergo cell division. The administration of testosterone propionate to old mice during compensatory renal hypertrophy results in an increased hypertrophy. The increase is relatively the same for irradiated and nonirradiated mice, indicating the lack of a long-term effect of x irradiation to reduce the ability of a target organ to respond to a hormone. The over-all conclusion of this study, with respect to radioinduced aging, is that x irradiation of the female Swiss mouse early in life does not have a pronounced effect on kidney function late in life but may have a long-term effect on those processes concerned with cell division. (auth)

23292 EFFECT OF AGE AT IRRADIATION ON LIFE SPAN IN THE MALE RAT. David C. L. Jones and Donald J. Kimeldorf (Naval Radiological Defense Lab., San Francisco). Radiation Res., 22: 106-15(May 1964).

The effect of a single exposure to a sublethal dose of fast neutrons in the juvenile and young adult male rat is to displace lifespan functions of survival rate, life expectancy, and age-specific death rate toward those typical of later chronologic ages. That is, survival rate and life expectancy are decreased, and age-specific death rate increased, as compared with sham-irradiated littermate controls. The magnitude of the displacement is inversely related to age at exposure from post-infancy up to middle age, and displacement is no longer discernible after irradiation at older ages. These findings, together with those in the literature, indicate that age at exposure, strain, and species are all important stipulations for consideration of the long-term effects of irradiation. (auth)

23293 EFFECT OF IRRADIATION ON THE TISSUE UPTAKE OF METHIONINE-2-C^{14} AND METHIONINE METHYL-C^{14}. Cecile H. Edwards, Evelyn L. Gadsden, and Gerald A. Edwards (Agricultural and Technical Coll. of North Carolina, Greensboro). Radiation Res., 22: 116-25(May 1964).

The uptake of methionine-2-^{14}C and methionine methyl-^{14}C by tissues and their distribution in water-soluble, hexane-soluble, and hydrolyzed protein tissue fractions was investigated in adult rats exposed to 700 r of x radiation. The uptake of methionine α-carbon and methyl carbon was less in brain, heart, kidney, and muscle of irradiated rats than in these tissues of control animals. The ability of bone marrow, liver, and spleen to accept these carbon atoms of methionine, however, was not affected by irradiation. The water, hexane, and protein tissue fractions of irradiated rats generally contained less ^{14}C arising from the α-carbon of methionine than those of control animals. When methyl-labeled methionine was administered, however, the higher ^{14}C content of the protein fraction of certain tissues suggested that irradiation may alter the utilization of the methionine methyl group. (auth)

23294 CYTOTOXIC EFFECT OF 2 AND 5 ROENTGENS ON HUMAN LYMPHOCYTES IRRADIATED *IN VITRO*. Stefan Stefani and Robert Schrek (Veterans Administration Hospital, Hines, Ill.). Radiation Res., 22: 126-9(May 1964).

Normal human blood lymphocytes were found to present *in vitro* a statistically significant sensitivity to x irradiation with 2 and 5 r. Two roentgens produced approximately 13 to 21% effect, and 5 r, 35% effect. (auth)

23295 EFFECTS OF GAMMA RADIATION ON RIBONUCLEASE. G. A. Hayden and F. Friedberg (Howard Univ., Washington, D. C.). Radiation Res., 22: 130-5 (May 1964).

When irradiated in the solid state, ribonuclease appears resistant to noticeable chemical covalent changes such as splitting of disulfide bonds or destruction of methionine, tyrosine, or phenylalanine even up to 45 Mr. Enzymatic activity declines markedly, however, and at a rate similar to the decrease to per cent hard-to-exchange amide hydrogens. When the ribonuclease is irradiated in solution, the rate of destruction of the amine acids and that of the lowering of per cent hard-to-exchange amide hydrogens are of similar magnitude. In terms of fraction of total amino acids rather than absolute number of molecules affected, smaller amounts of γ radiation are necessary to elicit for the ribonuclease irradiated in solution, a loss comparable in degree to that exhibited by the amino acids of the protein irradiated in the solid state. (auth)

23296 HEMATOLOGICAL EFFECTS OF PARTIAL-BODY AND WHOLE-BODY X-IRRADIATION IN THE RAT. Arland L. Carsten and Thomas R. Noonan (Brookhaven National Lab., Upton, N. Y. *and* Univ. of Rochester, N. Y.). Radiation Res., 22: 136-43(May 1964). (BNL-7531)

Rats were given lower-body (1000 r), upper-body (1800 r), or whole-body (750 r) exposures to x rays. All patterns of exposure caused about a 50% mortality. Mean survival times (of nonsurvivors) were approximately five days for the lower-body exposure and 11 days for the other two patterns of exposure. Measurements of hemoglobin, granulocyte, and lymphocyte levels were made for a period of four weeks postirradiation. Whole-body exposure produced a depression in hemoglobin and white cells which was more severe and prolonged than the decrease produced by a lethally equivalent exposure of either the upper or lower body. Both forms of partial-body exposure were followed by essentially the same pattern of change in granulocyte and lymphocyte levels, although the mean survival times associated with these patterns of exposure differed. The severity of lymphocyte depression after partial-body exposures was consistent with a direct effect on circulating lymphocytes, although the possibility of abscopal effects cannot be denied. Incorporation in erythrocytes of ^{59}Fe injected 24 hr after exposure was decreased in relation to the fraction of the body and, presumably, to the fraction of total marrow exposed and not to the gram-roentgen dose. These findings are interpreted as evidence that the mechanism of death in animals receiving an LD$_{50}$ dose of upper-body irradiation differs from the hematopoietic type of death seen in whole-body exposures of equivalent lethality. (auth)

23297 EFFECTS OF IRRADIATION ON THE METABOLISM OF SPERMATOZOA. M. Said Mounib and M. C. Chang (Worcester Foundation for Experimental Biology, Shrewsbury, Mass.). Radiation Res., 22: 144-54(May 1964).

Undiluted bull semen was exposed to 1000, 10,000, or 100,000 r of γ rays from a ^{60}Co source and then incubated in Ca^{++}-free Krebs-Ringer glucose medium for four hours. Irradiation depressed respiration and aerobic and anaerobic glycolysis of spermatozoa, and the depression increased as the dose increased. Immediately after irradiation motility of spermatozoa declined only after 100,000 r, and at the end of incubation period it declined after both 10,000 and 100,000 r. When the semen diluted with an equal part of yolk buffered with citrate (YC) or phosphate (YP) was irradiated with 100,000 r, the oxidative system was more radiosensitive than the glycolytic system of spermatozoa. Only with YC (1Y : 1C) was there a definite protection to respiration of irradiated spermatozoa, whereas all diluents offered some protection to their anaerobic glycolysis. In semen diluted with buffered yolk, sperm motility was protected directly after irradiation, although the motility declined at the end of the incubation period. In all cases the degree of protection tended to be higher when the ratio of yolk to buffer was 1 : 1 than when it was 1 : 5. (auth)

23298 ON THE GENETIC EFFECTS OF RADIOISOTOPE INCORPORATED IN DEOXYRIBONUCLEIC ACID. D. L. Simonenko. Radiobiologiya, 3: 633-43(1963). (In Russian)

An attempt was made to determine the genetic effects of certain radioisotopes in DNA molecules as a function of time. A new magnitude, genetically efficient, time is introduced. It is shown that P^{32} incorporated in DNA possesses a higher genetic efficiency than C^{14}. Comparisons show that the genetic efficiency of a given radioisotope varies with the amount of DNA present and with cell dimensions. (R.V.J.)

23299 EFFECTS OF X RAY ON HORSE BEAN PLANTULES AT VARIOUS OXYGEN PRESSURES. S. P. Semerdzhyan and N. G. Hop-Areyyan (Research Inst. of Agriculture, Echmadzin, USSR). Radiobiologiya, 3: 644-5(1963). (In Russian)

Horse bean plantules were x-irradiated to 90 r under oxygen and nitrogen pressure of 0, 1, 30, and 50 atm. Radiation damage was found to vary with the oxygen presence. Replacing oxygen with nitrogen reduced radiation damage. (R.V.J.)

23300 EFFECTS OF Co^{60} γ RADIATION ON THE TENACITY AND ISOELECTRIC POINT ON CELL PROTOPLASM IN VARIOUS TYPE COTTON. N. N. Nazirov (Tashkent Inst. of Genetics and Physiology of Plants). Radiobiologiya, 3: 651-6(1963). (In Russian)

The tenacity and isoelectric point of protoplasm cells were studied in 1306-DV early-, 108-F medium-, and S-1622 late-ripening Gossypium hirstum cotton roots 10 min, 2 hr, 1, 2, 3, 5, 7, 10, and 15 days following exposure from 500 to 2000 r of ^{60}Co γ radiation. Plant tenacity did not change during the first hours after exposure to 10 kr. However, decreased tenacity was observed after 24 hr in meristem cells of the roots and after 72 hr in epidermal cells in the C-1622 type and after 72 and 120 hr in the 1306-DB type. At 500 to 2000 r tenacity changes appeared much later. Small doses of γ radiation (200 r) increase the tenacity of protoplasm. In comparatively radioresistant 1306-DB cotton exposure to 2000 r did not effect the isoelectric point in seed protoplasm. While in the more sensitive C-1622 and 108-F types a dose of 200 r produced certain effects. 1000-r doses permanently shifted the isoelectric point to the acid side five days after exposure. (R.V.J.)

23301 ON THE MECHANISM REGULATING THE SYNTHESIS OF LIPIDS IN IRRADIATED ORGANISMS. I. K. Kolomiitseva (Inst. of Biological Physics, Moscow). Radiobiologiya, 3: 657-61(1963). (In Russian)

A review is given of published data on the influence of free radicals synthesis on fatty acid and cholesterol. Biochemical processes in lipid synthesis following irradiation showed certain regularities. (R.V.J.)

23302 MOBILITY OF FATTY ACIDS IN γ-IRRADIATED ANIMALS. M. A. Lomova. Radiobiologiya, 3: 662-6(1963). (In Russian)

Increased fatty acid metabolism in the blood of rabbits and rats was observed within 5 min following γ-irradiation. Within 2 hr the metabolism of liberated fatty acids was 50% above normal, but returned to the initial level after 24 hr. During the course of radiation sickness a second increase in fatty acid metabolism was observed in the blood. The general level of plasma lipids in irradiated animals showed periods of increase and decrease. It is shown that fatty acid mobilization takes place at various periods following irradiation. (R.V.J.)

23303 EFFECTS OF HIGH ENERGY PROTONS ON PHYSIOLOGICAL REGENERATION OF CORNEA EPITHELIUM. V. M. Mastryukova and A. D. Strizhizhovskii. Radiobiologiya, 3: 667-70(1963). (In Russian)

The influence of 126-Mev proton irradiation on the regeneration of cornea epithelium in mice was studied in 15 to 20 g mice exposed to whole-body doses of 200 to 500 r. It was found that irradiation inhibits mitotic activity and disturbs daily mitotic rhythm. The number of cells was not affected. The first day following exposure the genetic radiation effect, characterized by maximum chromosome aberrations, is a linear function of dose. The relative biological effectiveness of proton is 0.6 to 0.7. (R.V.J.)

23304 ACCUMULATION OF LABELLED ^{35}S MERCAMINE IN LIVER AND SPLEEN OF IRRADIATED AND NONIRRADIATED WHITE RATS. V. A. Bazanov (Inst. of Experimental Medicine, Leningrad). Radiobiologiya, 3: 671-6(1963). (In Russian)

Accumulation of ^{35}S labeled mercamine in liver and spleen tissues in irradiated and non-irradiated white rats was studied by histo-autoradiography and by calculating the radioactivity of tissue homogenates. High concentrations of ^{35}S were observed within 30 min following injections of labeled mercamine into the liver and spleen. At an early period following irradiation (1.5 hr after injection) destruction of mercamine in the liver is accelerated. Most of the mercamine is completely destroyed within 6 hr following injection. Excretion of the label is irregular, alternately increasing and decreasing. Most of the ^{35}S is excreted during the first day. (R.V.J.)

23305 ON DELAYED EFFECTS OF CHRONIC EXTERNAL RADIATION ON THE FUNCTIONAL STATE OF BONE MARROW-BLOOD FORMATION. L. V. Bogatov. Radiobiologiya, 3: 682-8(1963). (In Russian)

Remote effects of chronic irradiation (10 and 18 r per day to doses of 954 and 1300 r) indicated that after 4 to 7.5 years blood formation remained at a high level. Repeated bloodletting (1% of body weight) and acute irradiation with 600 r produced identical reactions, indicating good compensation and rehabilitation from previous injuries. Repeated bloodletting of normalized peripheral blood and bone marrow revealed insufficient hemoglobin formation and slowed hemoglobin restoration. (R.V.J.)

23306 COMPARISONS OF ALBUMEN AND α_3 GLOBULIN SERA ISOLATED BEFORE AND AFTER IRRADIATION OF DOGS. V. M. Rodionov and A. V. Chudinovskikh (Inst. of Biological and Medical Chemistry, Moscow). Radiobiologiya, 3: 691-7(1963). (In Russian)

High-voltage electrophoresis and chromatographic isolation of fermented albumen hydrolytes showed that albumen and α_3 globulin sera isolated from dogs before and after irradiation did not differ. Comparisons of chromatograms of peptides in albumen and α globulin showed a considerable difference in molecules in these proteins. (R.V.J.)

23307 IONIZING RADIATION EFFECTS ON MECHANISM OF ADAPTATION TO RISING TEMPERATURE IN SURROUNDING MEDIA. G. K. Gerasimova. Radiobiologiya, 3: 711-15(1963). (In Russian)

Melanophoric expression of temperature adaptation in frogs exposed to whole-body γ-irradiation was studied. Irradiation of frogs with 12 to 30 kr disturbed the mechanism of thermal adaptation. A high functional activity of hypophysis and suprarenal glands, with prevailing effects on the hypophysis melanophore hormones, was observed 3 to 4 days following the exposure. Reduced hormonal activity in the hypophysis and suprarenal glands was recorded from the 5th day until death. (R.V.J.)

23308 PARTICIPATION OF THALAMUS OPTICUS IN EARLY BRAIN CORTEX REACTION TO WHOLE-BODY IONIZING IRRADIATION OF RABBITS. A. N. Lebedev (Inst. of Higher Nervous Function and Neurophysiocology, Moscow). Radiobiologiya, 3: 721-6(1963). (In Russian)

The reactions of various structures of the Thalamus opticus to early changes in cerebral cortex bioelectric activity induced by ionizing radiation were studied. Preliminary one-sided damage of the post-ventricle Thalamus nuclei blocked the development of cerebral cortex bioelectric reactivity to whole-body x-irradiation with 1000 r during the first one or two hours after exposure. One-sided preliminary damage in pro-ventricle regions induced early post-irradiation shifts in bioelectric activity. Thus, intact specific Thalamus relay nuclei become a necessary condition for early cerebral cortex bioelectric reactivity to ionizing radiation. (R.V.J.)

23309 EFFECTS OF WHOLE-BODY X IRRADIATION ON THE PERIPHERAL NERVE SYSTEM IN THE LIVER. V. Ya. Karupu (Inst. of Physiology, Kiev). Radiobiologiya, 3: 727-30(1963). (In Russian)

Nerve elements in liver, studied in 34 rabbits whole-body irradiated with 1200 r and 6 dogs irradiated with 600 r, showed early pathological alterations that slowly increased. A considerable number of nerve structures remained irradiated throughout the course of illness. In addition to injuries of nerve structures a considerable compensation reaction was observed. (R.V.J.)

23310 CHANGES IN SYNAPSE OF CENTRAL NERVOUS SYSTEM OF DOGS DURING ACUTE RADIATION SICKNESS SYNDROME. A. G. Khanin (Inst. of Neurology, Moscow). Radiobiologiya, 3: 731-7(1963). (In Russian)

Morphological changes of intra-synaptic structures in the central nervous system during acute radiation sickness induced in dogs by a single whole-body irradiation with 600 r were characterized as toxic dystrophy. Microscopic studies classified the synapse conjugation changes as proliferate, dystrophic, necrobiotic, and necrotic. Histological analysis showed that structural disturbances of axodendritic intraneuron apparatus are larger than the axosomatic formations. The damage to synaptic structure was more pronounced in sensitive neurons, somewhat less in vegetative neurons and reticular cells, and still less in cerebral and spinal motor neurons. (R.V.J.)

23311 ON THE PLOIDY AND RADIOSENSITIVITY OF YEAST CELLS. V. S. Barsukov, O. V. Malinovskii, and N. M. Mityushova (Pavlov Inst. of Physiology, Leningrad). Radiobiologiya, 3: 738-44(1963). (In Russian)

A functional bond exists between the recovery rate and survival of irradiated yeast cells. The different radiosensitivities of various yeast strains, independent of ploidy, is explained by different restoration rates. (R.V.J.)

23312 SENSITIVITY OF VARIOUS TREE SEED TO IONIZING RADIATION. G. F. Prevalov (Inst. of Cytology and Genetics, Novo, Sibirsk, USSR). Radiobiologiya, 3: 770-2(1963). (In Russian)

The radiosensitivity of seed from 30 types of trees, predominantly fruit and pine, was investigated. Critical doses are tabulated. (R.V.J.)

23313 RADIATION CATARACT IN CLINICAL THERAPEUTIC RADIOLOGY. R. G. Parker, L. L. Burnett, P. Wootton, and D. J. McIntyre (Univ. of Washington, Seattle). Radiology, 82: 794-9(May 1964).

Recognized changes in the crystalline lens of the human eye incident to absorption of ionizing radiation are nonspecific. Other associations include many forms of physiological insult: aging, systemic illness (diabetes), pigmentary degeneration of the retina, and medications (adrenal cortical steroids). Therefore, a cause-and-effect relation must be assumed with caution and can be definite only on a statistical basis. Radiation-related lens changes were few (4 out of 85 lenses) and followed substantial dosage (2,040 to 3,900 rads) delivered in equal daily increments over 46 to 85 days. Of 30 lenses receiving more than 500 rads in 32 to 93 days, 20 are without significant change and 6 have equivocal changes at postirradiation intervals of two and a half to 15 yr. Of 14 lenses receiving over 1,000 rads, 8 (1,040, 1,050 (3 cases), 1,100, 1,120+, 1,250, and 1,260 rads) are without significant change, and two have equivocal changes at postirradiation intervals of five to 13 years. The primary clinical concern is the incidence and severity of visual loss related to radiation change. Only two of 85 eyes had grossly diminished visual acuity probably related to radiation. In both instances, the eye was heavily irradiated (3,570+ and 3,900+ rads) because of suspected orbital extension from maxillary sinus neoplasm. The alternative treatment was orbital exenteration. Both patients, 75 and 78 yr old, function satisfactorily with normal vision in the other eye. Therefore, cataract extraction was not indicated. (auth)

23314 THE RELATIVE BIOLOGICAL EFFECTIVENESS OF HIGH-ENERGY PHOTONS AND ELECTRONS. Warren K. Sinclair (Argonne National Lab., Ill.) and Henry I. Kohn. Radiology, 82: 800-15(May 1964).

The concept of relative biological effectiveness (RBE) and the physical and biological considerations in the determination of RBE are discussed, with particular reference to the RBE of high-energy photons and electrons. Earlier reviews of work in this field are critically considered and recent measurements of RBE in this energy region are tabulated and discussed. It is concluded that there are no differences of practical significance between high-energy photons and electrons from 1 to 70 Mvp and that for most biological end-points the RBE (with 200-kvp x rays as the standard) is about 0.85 to 0.90. Some radiobiological aspects, particularly with reference to RBE's at other parts of the LET spectrum, are also discussed. (auth)

23315 DATA ON THE PROPHYLACTIC AND THERAPEUTIC EFFECT OF PROPAMINE AND BICILLIN-3 ON EXPERIMENTAL STAPHYLODERMIA IN IRRADIATED RABBITS. N. L. Solomin. Sb. Nauchn. [Tr.] Rabot Sverdlovsk. Nauchn.-Issled. Kozhno-Venerol. Inst. Kafedry Kozhno-Venerol. Boleznei, Sverdlovsk. Gos. Med. Inst., No. 4, 186-96(1962).

The clinical picture and course of experimental Staphylococcus infection and the prophylactic and therapeutic effect of β-mercaptopropylamine and bicillin-3 on the infection were studied in rabbits which were subjected to x irradiation at doses of 700 r. A skin infection was induced on the 8th day after irradiation by the subcutaneous administration of a culture of hemolytic *Staphylococcus aureus*. β-mercaptopropylamine at a dose of 25 mg/kg body weight was intravenously injected 10 min prior to irradiation. Bicillin-3 at doses of 200,000 units/kg body weight was intravenously administered on the day of the inoculation, and subsequently thrice, once every fourth day. Staphylococcus infection aggravated the condition of the irradiated animals, its course being more severe and longer than in the control animals. β-Mercaptopropylamine had a beneficial effect on the course of the radiation syndrome and infection. The peripheral blood picture of the irradiated and infected animals bears out the beneficial effect of β-mercaptopropylamine on the protective capacity of the organism, and the effectiveness of the antibacterial action of bicillin-3. (OTS)

23316 THE ROLE OF RADIATION IN CELL BIOLOGY. P. P. Dendy (Univ. of Cambridge, Eng.). Sci. Prog. (London), 52: 191-204(Apr. 1964).

Some of the ways by which radiation damage may develop within a cell are discussed in fairly general terms. The ideas which are considered include the target theory, the importance of the overall organization of the cellular metabolism, the effects of membrane puncture, and the enzyme release hypothesis. By way of summary, some of the basic stages in the development of radiation damage are presented schematically. Two aspects are discussed in more detail. First the importance of the formation of free radicals after irradiation and the value of electron spin resonance for their detection are considered. Secondly, because of its role as a carrier of genetic information, some of the effects of radiation on deoxyribonucleic acid synthesis are considered, particularly in relation to the cell cycle. Provided the effects of radiation on cellular metabolism are considered in general terms a reasonably coherent picture can be constructed. Work on the detailed mechanisms which lead to the final biological effect is still at a relatively early stage. (auth)

23317 RADIATION GENETICS OF THE RHESUS MONKEY, *MACACA MULATTA*. I. THE EFFECT OF DIFFERENT DOSAGES OF γ-RADIATION ON THE CHROMOSOME ABERRATIONS IN THE SPERMATOGENESIS OF *MACACA MULATTA*. C. C. Tan, T. T. Liu, T. S. Chang, S. F. Chiu, S. T. Lai, and C. L. Siu (Futan Univ., Shanghai). Sci. Sinica (Peking), 13: 611-19(Apr. 1964).

It is concluded that the increase in the frequency of chromosome aberrations, either expressed in terms of the percentages of cells carrying aberrations or expressed in terms of the percentage of chromatin bridges during the spermatogenesis of the rhesus monkey, *Macaca mulatta*, is apparently in an exponential relation with the increase of dosage of gamma radiation, that is, when the dosage becomes doubled, the frequency of aberrations increases 4 fold. Any dosage below 50 r, however, appears to give a negligible effect. The frequency of aberrations obtained in the respective cases of 5 r, 10 r, and 25 r exposure shows no difference from the results of the 50 r treatment. Rather unexpectedly, the results obtained from the 10 r treatment give a frequency much higher than those from the 50 r treatment. The reason for this is not clear, though it may be ascribed to the individual variations of the monkeys themselves or to the probable error of the exposure dosages, or else to a specific effect of the 10 r treatment. The last possibility cannot be entirely excluded, for in another experiment, a similar situation was also found. (auth)

23318 EFFECTS OF IONIZING RADIATION ON SOILS AND SUBSEQUENT CROP GROWTH. H. J. M. Bowen and P. A. Cawse (United Kingdom Atomic Energy Authority, Wantage, Berks, Eng.). Soil Sci., 97: 252-9(Apr. 1964).

Two soils were treated with ionizing radiation at a range of doses from 0.001 to 60 megarads. Most physical and chemical properties measured subsequently showed little change, apart from the exchangeable N, which increased markedly, and the rate of loss of water, which decreased slightly. Evidence was obtained that supported the hypothesis that the extra N appears primarily as ammonia, which is microbiologically oxidized to nitrate if the soils have not been sterilized. It arises from N immobilized in soil organic matter in three ways: rapidly, by radiation decomposition; more slowly, by the action of enzymes such as urease, which are resistant to radiation; or by microbial action. The last two modes of production can be inhibited by boiling the soils in ethanol, or by irradiating and incubating under dry conditions. The G values for the production of ammonia from the two soils by the first process were 0.060 and 0.061. Growth of lettuce and barley was shown to be consistently stimulated in soils which had received 0.02 to 2 megarads, and under suitable conditions after 0.005 megarads. The stimulation is believed to be caused mainly by the increase in available nitrogen. (auth)

23319 PAPER CHROMATOGRAPHIC INVESTIGATION OF THE FREE AMINO ACID FOLLOWING X-RAY IRRADIATION ON THE RADIOLOGICAL PRACTICIANS. Toru Miyazaki (Wakayama Medical Coll., Japan). Wakayama Med. Rept., 8: 15-20(Mar. 1963).

Investigations of the blood picture and changes of amino acid fractions and the content of amino acid nitrogen in blood serum in radiological workers showed that there was an increase in the quantity of free amino acids in serum together with an increase in amino acid nitrogen. Among various amino acids, usual increases were found in glycine, aspartic acid, and proline as compared with healthy normal adults, and an increase of alanine, glutamine, glutamic acid, and serine-ornithine was observed in a few cases. It was concluded that the observation of amino acids in blood serum helps the early diagnosis of radiation injuries. (auth)

23320 RADIATION AND CHEMICALLY INDUCED MUTATIONS IN DURUM WHEAT. F. D'Amato (Università, Pisa, Italy). p.243-6 of "Symposium on Genetics and Wheat Breeding, June 12-14th, 1962." [Martonvásár, Hungary, Agricultural Research Inst. of the Hungarian Academy of Sciences, 1962].

Results are summarized from a series of studies on mutations in three varieties of durum wheat (*Triticum durum*) induced by exposure of dry seeds to various doses of x radiation, thermal neutrons, fast neutrons, diethyl sulfate, or ethyl methane sulfonate. Data are presented on seed germination, seedling growth, field survival, frequency of M_1 plants with pigment-deficient sectors, and mutations and mutation frequencies in the second generation. Nearly 400 independently obtained mutations were isolated, some of which were considered promising for crop improvement. A comparative study of the types and frequencies of chlorophyll mutations demonstrated that the mutation spectra induced by the various types of ionizing radiations are not different from each other, while statistically significant differences were observed between the chemically and radiation-induced spectra. (C.H.)

23321 STATE OF THE SUPRARENALS IN RADIATION SICKNESS UNDER CONDITIONS OF CHEMOPROPHYLAXIS. B. V. Blinov. p.12-13 of "Akademiya Medetsinskikh Nauk, SSSR." Sukhumi. 1963.

Adrenaline in combination with acetylcholine was administered to guinea pigs 5 to 10 min prior to their exposure to gamma radiation at lethal doses of 450 r. The protein metabolism of the nucleoprotein fraction of the suprarenals, as determined by the inclusion of ^{32}P, was 76% higher in the protected animals three hr after irradiation than in the unprotected animals; it then decreased, remaining, however, at a higher level than in the control animals during 15 days of observation. Protection resulted in a survival rate of 30 to 40%. (OTS)

23322 FUNCTIONAL CONDITION OF THE CORTICAL LAYER OF THE SUPRARENALS IN RADIATION SICKNESS UNDER CONDITIONS OF APPLIED PROTECTIVE PROPHYLACTIC SUBSTANCES. B. A. Fedorov. p.82-3 of "Sbornik, Materialy Nauchnoi Konferentsii Instituta Experimental'noi Patologii i Terapii, Akademiya Meditsinskikh Nauk SSSR." Sukhumi. 1963.

Total-body x irradiation of rats with doses of 600 r (LD_{50}) induced phase modifications of the cholesterol content in the suprarenal gland tissues. A decrease of 50 to 70% was noted in the first hours following irradiation; an increase of 120 to 130% beginning with the end of the first 24 hr and during the subsequent 4 to 5 days, with a prolonged second decrease in the period of the next 5 to 15 days. The administration of cysteamine or adrenaline with acetylcholine to the rats prior to irradiation had no effect on the modification of the cholesterol content in the first two phases of the disease, but prevented the second decrease in the third phase, thus contributing to the active functions of the suprarenals during the entire period of radiation sickness. (OTS)

23323 SPECIES COMPARISONS OF RADIATION RESPONSE OF THE GONADS. E. F. Oakberg and Evelyn Clark (Oak Ridge National Lab., Tenn.). p.11-24 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

Recent advances in the understanding of gametogenesis are analyzed in terms of the radiation response of mammalian germ cells. Species variations are attributed to differences in duration of spermatogenesis, in length of cell division cycles, in total reproductive span, and in possible differences in radiosensitivity at the cellular level. The relative effectiveness of fractionated versus single doses depends upon a combination of number and size of fractions and upon interval between doses. High sensitivity to cell killing during the last pre-meiotic divisions, a lower sensitivity of meiotic prophase stages, and a very low sensitivity of mature gametes is characteristic of both males and females. Nuclear organization in cell killing is emphasized in spermatogonia and oöcytes. It is concluded that similar cell stages, in widely diverse organisms and tissues, have similar radiation response. At present it is believed difficult to demonstrate conclusively the primary sites of damage that result within the cell. Data also suggest that the variation in nuclear cytology of the arrested oöcyte may be greater than previously realized. If verified, this hypothesis would permit explanation of much of the species variation in fertility of irradiated females on the basis of known differences in response of meiotic stages within species. (H.M.G.)

23324 IONIZING RADIATIONS AND REPRODUCTIVE CAPACITY. Roberts Rugh (Columbia Univ., New York). p.25-43 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

Current knowledge of ionizing radiation effects on sperm, ova, and embryos is reviewed. Using the Hertwig effect, parthenogenesis was produced in fish, but the method was unsuccessful in mice. Radiation effects on sterility of male and female are compared. Generalizations derived on embryonic radiation injuries are: that embryological concept of a critical period of the causation of specific x-radioinduced congenital anomalies is not so clear cut as originally conceived; radiosensitivity of the embryo bears no consistent relation to its increasing developmental capacity; it is unwise to extrapolate from one species to another, whether it be in regard to germ cell or embryonic effect of x irradiation; when an embryonic cell is radiation-injured, it is quickly eliminated by the embryo, sloughed off or phagocytized; it is conceivable that any x irradiation of the early embryo could be without some permanent effect; heterosis is a factor in embryonic radiosensitivity; and it does not suffice to demonstrate that certain stages in the maturation process can survive a specific level of x irradiation and give rise to mature stages by meiosis. (H.M.G.)

23325 ACUTE IRRADIATION EFFECTS ON REPRODUCTIVITY OF DIFFERENT STRAINS OF MICE. John W. Gowen and Janice Stadler (Iowa State Univ., Ames, Iowa). p.45-58 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

The effects of x rays on total lifetime fertility and total lifetime progeny as a whole and as distributed by litter sequence and dosage of x ray to which either the male parent or female parent was exposed are considered. A pronounced difference in the progenies where male parents are irradiated as contrasted with those where the female parent is irradiated is shown. Acute irradiations from 0 to 320 r scarcely affected male fertility or the size of litters obtained at each successive gestation. After 320 r, male fertilities, the number of their litters, and the numbers of progenies within litters, decreased orderly on an irradiation dose-dependent basis. Irradiated female fertilities, the numbers of their litters, and the numbers of the progenies, all decreased regularly with the beginning of the lowest dosages of irradiation, 20 r. Comparisons of the sex ratios for the two sets of data show that the sex ratios of the progenies are uninfluenced by irradiations to either the male or female parents. Comparisons of the means of first litter performances with those of the whole life span indicated that fair confidence may be placed in the characteristics of first litters as indicators of lifetime performance. (auth)

23326 THE EFFECTS OF CHRONIC WHOLE-BODY IRRADIATION ON THE REPRODUCTION OF C57 BLACK MICE. J. de Boer (Special Weapons Center, Kirtland AFB, N. Mex.). p.59-72 "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

When C57 black mice were exposed to low dose rate chronic gamma radiation from a ^{60}Co source, the reproductive ability of the male was more adversely affected than the reproductive ability of the female. First litter produced used as a measure of determining the reproductive ability and/or reduced fertility was valid when one considers the age effect which was shown in each experimental group as well as in all control groups. In general, sterilizing effects produced by radiation were decreased with decreased dose rates. Also, reduced fertility as a function of age increased with increased age. There were strong indications suggesting an increased influence of the endocrines on the function and development of the reproductive tissues when these tissues are exposed to ionizing radiation or that there is an overall radiosensitivity of the endocrine system to ionizing radiation. On the basis of this experiment, no conclusion can be drawn which would indicate that the reproductive lifespan of these mice was shortened as a result of ionizing radiation. More specific phenomena and their relation toward each other will have to be worked out before the reproductive system can be employed as a biological dosimeter for radiation exposure. (auth)

23327 EFFECTS OF IONIZING IRRADIATION OF GAMETES AND ZYGOTES ON THE EMBRYONIC DEVELOPMENT OF RABBITS AND HAMSTERS. M. C. Chang and E. B. Harvey (Worcester Foundation for Experimental Biology, Shrewsbury, Mass.). p.73-89 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

Published and unpublished results on effects of irradiation of hamster ovarian oöcytes in vivo, unfertilized and fertilized rabbit ova in vitro, ejaculated and epididymal rabbit spermatozoa in vitro, and of pregnant hamsters and rabbits are described with special reference to fertilization, embryonic mortality, and fetal abnormalities. It was found that irradiation of gametes in vitro at extremely high levels led to no impairment in the process of fertilization in vivo, but subsequent development of fertilized ova was severely disturbed. In attempting to distinguish between direct effects on the embryos and indirect effects acting via the mother, it was found that irradiation of the maternal organism alone exerts a harmful effect on embryonic development, which is even more severe when the pregnant animal (maternal organism plus embryos) is irradiated. The stage of pregnancy at which the radiation insult is applied has an important bearing on the incidence of embryonic mortality and on the nature of any fetal abnormalities that might result. (auth)

23328 EFFECT OF CONTINUOUS RADIATION ON REPRODUCTIVE CAPACITY AND FERTILITY OF THE ALBINO RAT AND MOUSE. Sidney O. Brown, George M. Krise, Henry B. Pace, and Jelle de Boer (Texas Agricultural and Mechanical Coll., College Station). p.103-10 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

A chronic gamma-radiation field of 2 r daily over a 23-hr period is not incompatible with continued reproduction in the albino rat for 10 generations. The reproductive ability of mature female rats is not reduced by chronic gamma radiation of 2, 5, and 10 r daily, and reproduction at approximately normal rate can take place for four successive litters in rats remaining continually in a 20-r daily field. Chronic gamma radiation in daily doses of 2, 5, 10, 20, and 50 r is compatible with the production of viable offspring when the mothers are placed in the radiation field at the time of conception. Albino mice produce viable young when given 2, 5, 10, and 20 r gamma-radiation doses daily over a 23-hr period. The fertility of males of these offspring is less influenced by chronic gamma radiation than that of the females. (auth)

23329 OBSERVATIONS ON THE EFFECTS OF CONTINUOUS IRRADIATION OVER TEN GENERATIONS ON REPRODUCTIVITIES OF DIFFERENT STRAINS OF MICE. Janice Stadler and John W. Gowen (Iowa State Univ., Ames, Iowa). p.111-22 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

A record of the effects of 22 hr/day continuous irradiation with ^{60}Co on progenies and sex ratios of first litters for each of the ten continuing generations following the first exposures is presented. The daily irradiation dosages varied on the average from 1.3 to 2.6 r/day, dependent on the position of the mouse cages. The results showed that within these ranges the mice maintain numbers in their first litters which were directly comparable with those observed for unirradiated mice of each strain at the same corresponding reproductive periods within the colony. Similar observations on sex ratios of these progenies, as measures of possible lethal changes in the sex chromosomes, showed that these changes do not support increased radioinduced mutations since the sex ratios remained nearly constant throughout the 10 generations. Instead the factors that were most important in the reproductive worth of the irradiated and unirradiated mice were the same in each group, time when fertility was initiated, well-balanced reproductive sequence, and litters adjusted to the physiological capacities of their parents. Search for visible gene mutations did not reveal any in the untreated series of mice, although the breeding pattern was such as to bring them out should they occur. A similar search of the irradiated progenies showed one mutation to a recessive brachypod type. This mutation corresponded to a similar mutation which occurred in an entirely separate experiment but within the same inbred forebears. One mutation occurred under low dose continuous irradiation, the other under high dosage acute irradiations. The fact that the mutations occurred in the same inbred ancestry suggests that the BALB/Gw line may be of a genetic complex which favors this mutational type. The total accumulated high-energy irradiation dosages were in the neighborhood of 1500 r to the 10th generation mice. By the time the first generation litters were born the mothers had received total dosages that were more than sufficient to sterilize most of them should the irradiation be given at a single acute treatment, yet reproductivity and sex ratio remained normal for these parental pairs. The same reproductive performances were observed in the mice that became parents in the successive generations even though the radiation dosages absorbed during ancestral development increased much beyond those of the acute lethal range. (auth)

23330 LATE TESTICULAR LESIONS IN IRRADIATED MONKEYS. James A. Pitcock (Univ. of Texas, Austin). p.153-64 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

Prepubertal monkeys (Macaca mulatta) were exposed to acute and fractionated gamma and gamma plus neutron radiation. They were found to have histologic lesions in their testes three to eight yr after the radiation was administered. The severity of the lesion was proportional to the dose received, although great individual variability was noted. The monkey seems to be qualitatively similar to the small laboratory animals previously studied, but is more sensitive to the development of permanent testicular lesions. (auth)

23331 THE DIFFERENTIAL RADIOSENSITIVITY OF MALE PRIMORDIAL GERM CELLS AND SPERMATOGONIA. Anita M. Mandl, Heather M. Beaumont, Gillian C.

Hughes, L. K. Harding, and E. A. Jones (Univ. of Birmingham, Eng.). p.165-74 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

The relative radiosensitivity of germ cells at different developmental stages is more difficult to establish accurately in the male than the female. Experiments were therefore undertaken to compare the radiosensitivity of male and female germ cells at corresponding stages of development. As in the case of the female, an attempt was made to correlate observations on radiosensitivity with the developmental stage of the germ cells at the time of irradiation. Studies of rats pertaining to developmental history of male germ cells, population of male germ cells, and radiosensitivity at different stages of development are reviewed. (H.M.G.)

23332 COMPARISON OF EFFECTS PRODUCED BY HIGH DOSES OF IONIZING RADIATION AND OESTROGENIC HORMONE ON THE SEMINIFEROUS TUBULES OF RAT TESTES. Dennis Lacy (St. Bartholomew's Hospital Medical Coll., London). p.189-212 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

Studies were made to determine what factor or factors were responsible for maintaining the high degree of radial coordination shown by the germ cells in the seminiferous tubules of rats. In addition to the testes of normal animals, the effects of high doses of ionizing radiation and treatment with estrogenic hormone were also observed. Radiation doses of 10,000 r were acquired using a beam of electrons from a 14-Mev linear accelerator. Degenerative changes shown by particular types of cells were studied, and an analysis of the large amount of lipid that appears in the tubules both after irradiation and treatment with estrogenic hormone was made. It was apparent from the work done that there is a basic similarity between the general course of events that occur in the seminiferous tubules after irradiation and during treatment with estrogenic hormone. Thus after both stresses many germ cells degenerate and are phagocytosed by the Sertoli cells. This is accompanied by a marked increase in the lipid content of the Sertoli cells, much of which appears to be derived from the germ cells. There is also much in common in the way the two stresses affect the young spermatids in that both lead to an apparent loss of chromatin from the inner regions of young spermatid nuclei and an increase at the periphery. The essential difference between the effect of high doses of ionizing radiation on the seminiferous tubules as compared with that caused by estrogenic hormone is that the former causes total destruction of the spermatogonia. (H.M.G.)

23333 THE EFFECT OF SEX STEROIDS ON ENDOGENOUS RESPIRATION OF X-IRRADIATED TESTIS. Emil Steinberger (Albert Einstein Medical Center, Philadelphia). p.213-17 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

The endogenous respiration of testicular tissue was studied following x irradiation and treatment with sex steroids. Treatment of x-irradiated animals with estradiol benzoate partly prevented the x-irradiation-induced rise in respiration. Treatment of intact animals with estradiol produced a rise in endogenous respirations. Treatment of x-irradiated animals with testosterone propionate completely prevented the rise in respiration. The estradiol-induced rise in respiration could be prevented by concomitant administration of testosterone propionate. (auth)

23334 EFFECT OF IONIZING RADIATION ON SPERMATOZOAN METABOLISM. S. H. Wu and J. R. Prince (Oregon State Univ., Corvallis). p.219-27 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

It was demonstrated that the different activities of the sperm cell show different degrees of sensitivity to ionizing radiation. Irradiation at doses that greatly depress the spermatozoan motility may not at all affect their respiration. Exposure up to 10,000 r of x irradiation did not show any noticeable effect on the oxygen uptake or survival of bovine sperm cells. Even at higher intensities: 100,000, 320,000, or 640,000 r of gamma irradiation from ^{60}Co, the impairment of respiration was not immediately apparent. Effect of irradiation on sperm DNA in terms of relative absorbance of DNA-Feulgen complex, was not detectable at 30,000 r of gamma irradiation. At 320,000 r, however, the DNA-Feulgen complex of the irradiated cells was significantly affected. Rabbit spermatozoa, even with its richly endowed seminal catalase, are more sensitive, with respect to sperm motility, to ionizing radiation than spermatozoa of bovine or ram. (auth)

23335 GYNOGENESIS IN VERTEBRATES: FERTILIZATION BY GENETICALLY INACTIVATED SPERMATOZOA. R. A. Beatty (Edinburgh Univ.). p.229-41 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

Gynogenesis is the fertilization of an egg by a genetically inactivated spermatozoon. The spermatozoon retains its function of activating the egg to complete the final maturation division and begin development as a haploid with chromosomes of maternal origin only. The resulting false hybrids are called gynogenones. The chief gynogenetic agents to which spermatozoa may be exposed are radium irradiation, x rays, ultraviolet light, and ordinary light in the presence of photosensitizing dyes. Gynogenones can attain an advanced stage of development in Amphibia but appear to perish at a very early stage in mammals. Gynogenesis is the normal mode of reproduction in some invertebrates. The significance of gynogenesis is discussed with particular reference to genetics and to spermatozoan function, and in other biological contexts. (auth)

23336 EFFECTS OF IONIZING RADIATION AND ISOTOPE STUDIES ON MALE ACCESSORY SEX ORGANS. Paul L. Risley (Univ. of Oregon, Eugene). p.243-61 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

To better understand and evaluate radiation damage to interstitial cells, the response of the male accessory sex organs to radiation was studied. An early series of experiments was concerned with ^{32}P utilization by testes and male accessory organs in hamsters. Mean specific activities of acid-soluble ^{31}P and ^{32}P, lipid ^{31}P and ^{32}P, and residual protein. Phosphorus-31 and ^{32}P were calculated for hamster testes, epididymides, seminal vesicles, and prostate glands. Normal adult males were compared with hemicastrates, castrates, prepubertal young, and testosterone-treated young. A further series of experiments was conducted on the hamster epididymis in order to investigate the possibility that regional differences in ^{32}P uptakes could be detected. A distinct pattern of ^{32}P distribution was seen at 48 hr after injection regardless of the dose range. Radioautography was used to compare the distribution of ^{35}S with that of ^{32}P in the epididymis. It was concluded that S-containing materials appeared to be concentrated in the cauda epididymidis and vas deferens. Similar methods were used to compare the ^{32}P uptakes and concentrations of ligated and non-ligated epididymides.

Another parallel experiment was made with six hemicastrate hamsters. Progressive uptakes and normal distributions were noted for the normal sides. However, the hemicastrate epididymides showed fluctuating uptakes in the caput regions and higher values again in the lower cauda with depleted sperm stores. A final experiment involved a comparison of ^{32}P concentrations in the testis, the upper caput, and the lower cauda epididymidis in 16 adult animals over a 16-day period following a single ^{32}P injection. There was a higher ^{32}P activity in the corpus and upper cauda epididymis than in other regions of the male reproductive tract. It was concluded that radioactivity measurements of injected ^{32}P could be used as a fairly sensitive method to measure altered general metabolic changes in the male accessory sex organs in response to hormonal factors, vitamin and nutritive deficiencies, pharmaceutical agents, ionizing irradiations, or other physiological effects. (H.M.G.)

23337 THE EFFECT OF TESTICULAR X-IRRADIATION ON BULL SEMEN. E. L. Gillette, M. L. Hopwood, W. D. Carlson, and F. X. Gassner (Colorado State Univ., Fort Collins). p.269-77 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

The effects of direct x irradiation of the testicles of bulls given in a single exposure of 50, 100, 200, 400, or 800 r were reported. Increases in numbers of morphologically abnormal sperm were seen as early as four to five weeks after irradiation. Decreases in sperm numbers were seen as early as seven weeks after exposure to 800 r with longer periods of time required to observe changes in sperm from bulls exposed to lower radiation levels. The physical score of semen decreased five weeks after exposure to 800 r and 400 r with longer periods of time required to observe changes in semen from bulls exposed to lower radiation levels. Radiation depressed fructolysis rates and oxygen consumption for indefinite periods in semen from bulls in all exposure levels. An increase in the amount of initial fructose in semen was found to correlate with decreases in sperm numbers. Seminal free amino acids and ascorbic acid levels remained relatively unchanged throughout the experiment. The greatest degree of change was observed to occur around 14 weeks after irradiation. Recovery was observed between 30 and 40 weeks after irradiation for most of the criteria studied. Sperm concentration returned to only 65% of preirradiation values at 40 weeks after exposure to 800 r and this level was maintained until termination of the study 52 weeks postirradiation. (auth)

23338 SOME RESULTS OBTAINED IN THE IRRADIATION WITH X RAYS OF TESTES OF LAMBS. M. Courot (Centre National de Recherches Zootechniques, Jouy-en-Josas, France). p.279-86 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

Eighteen male lambs were irradiated locally with x rays for analysis of the supporting cells and of the gonocytes present in the seminiferous tubules. The lambs received a single dose of 500, 1000, or 2000 r at either of two ages, 18 or 63 days. The testes were removed by castration at different intervals after irradiation. Results indicate that in the testes of the very young lambs the precursors of the Sertoli cells are very sensitive to x rays, doubtless at least as sensitive as are the primordial germ cells. On the other hand, a single dose of x rays, administered at a time where the germinal cells have not yet exhibited spermatogenic activity, may have a repercussion after a very long time. This is manifested only in the course of the meiotic prophase and spermiogenesis. (H.M.G.)

23339 EFFECTS OF IONIZING RADIATION ON SEA URCHIN SPERM AND MECHANISM OF FERTILIZATION. Albert Tyler (California Inst. of Tech., Pasadena). p.287-95 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

Experiments on the effects of ionizing radiation on sea urchin sperm are reported, and current notions of the mechanism of fertilization are discussed. The fertilizing capacity of *Lytechinus pictus* sperm exposed to various amounts of irradiation up to 18,000 r and the percentage cleavage of eggs fertilized by these sperms were determined. At the highest dose employed in the experiment, less than one percent of the sperm retained their fertilizing capacity. None of the eggs fertilized by the irradiated sperm developed normally. (H.M.G.)

23340 THE DIFFERENTIAL RADIOSENSITIVITY OF OOGONIA AND OOCYTES AT DIFFERENT DEVELOPMENTAL STAGES. Anita M. Mandl and Heather M. Beaumont (Univ. of Birmingham, Eng.). p.311-21 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

Changes in the structure and population of female rat germ cells that occur during the development of the ovary are reviewed and observations on the relative radiosensitivity of the rat female germ cells are summarized. Fetal germ cells are highly radiosensitive at 15.5 days post coitum (p.c.). This finding may be correlated with peak mitotic activity of the oögonia at this stage. Male germ cells appear to be fairly radioresistant at the same stage of development. Sensitivity of the female germ cells decreases between 15.5 and 17.5 days and is minimum at 19.5 days p.c. when the majority of oöcytes are at the zygotene stage. As zygotene gives way to pachytene, a stage associated with greater chromosomal condensation due to coiling, radiosensitivity increases. Therefore, it is concluded that up to the end of the pachytene stage, the radiosensitivity of oöcytes is in general correlated with changes in chromosomal condensation. A table was constructed showing the effects of exposure to 100 r on germ cells at different developmental stages. From the table there can be little doubt that the most radiosensitive stage of all is the first metaphase of meiosis, and the least radiosensitive zygotene and late dictyate. (H.M.G.)

23341 REPRODUCTIVE ABILITY OF THE AGING X-IRRADIATED AND SHAM-TREATED FEMALE BEAGLE. A. C. Andersen (Univ. of California, Davis). p.323-31 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

Evidence is presented that reproduction is not seriously impaired by whole-body x irradiation of female beagles. Estrous periods in bred and nonbred dogs from control and irradiated groups compared favorably until early senescence. Thereafter, 300-r exposed dogs showed fewer estrous periods with advancing age, though the estrus manifested had fewer irregularities. This finding in the dog may be similar to well-documented evidence of treating menstrual irregularities in humans by low (40 to 80-r) radiation exposure. To date there is no evidence that either fertility or the ability to raise young is impaired by midlethal x-ray exposure given during puppyhood, shortly before or at puberty. (auth)

23342 THE EFFECTS OF CHRONIC AND LD$_{50}$ X-RAY DOSES ON THE REPRODUCTIVE POTENTIAL OF SHEEP. John L. Terry, Jr., Logan A. Damewood, and J. de Boer

(Air Force Special Weapons Center, Kirtland AFB, N. Mex.). p.333-5 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

The reproductive potential of 40 ewes, exposed to acute, whole-body x irradiation was reduced. Doses equal to the acute doses segmented over time did not cause reduced reproductive potential of ewes. The developing fetus in the ewes exposed to intermittent doses of 100, 50, 25, or 10 r at a dose rate of 8 r/min showed no gross abnormalities. Direct damage to the ovaries may not be so severe as indirect damage, since the dose rate employed was constant and repair, replacement, or recovery of cellular components of ovarian tissues following irradiation was not shown thus far. Doses causing reduced reproductive potential of ewes were higher than was anticipated; also, the difference in response to acute and chronic exposures were greater than was anticipated. The average weaning weight of lambs produced by irradiated ewes was not statistically different from those from control ewes. (auth)

23343 THE EFFECTS OF CONTINUOUS PRE- AND POSTNATAL IRRADIATION ON REPRODUCTION IN THE ALBINO RAT. I. A PRELIMINARY REPORT. H. B. Pace, G. M. Krise, and S. O. Brown (Texas Agricultural and Mechanical Coll., College Station). p.337-47 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

Pregnant female albino rats were exposed at various rates of 0, 1, 2, 5, 10, and 20 r/23-hr day, to ^{60}Co gamma irradiation from the 15th day of gestation until littering. The offspring were continuously irradiated at these rates until they were 23 days of age, then removed from the radiation environment. At specific periods, 63, 176, and 300 days, representative samples of male offspring were sacrificed for organ weight and histological analysis of the reproductive system and related organs. The effects of total doses ranging from 30 to 600 r in the testes and related reproductive organs are considered. (auth)

23344 X-IRRADIATION EFFECTS ON REPRODUCTIVE FUNCTION IN THE FEMALE HAMSTER. Gerald Brooksby, Frederick Sahinin, and A. L. Soderwall (Univ. of Oregon, Eugene). p.349-60 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

Whole-body x irradiation to young adult female hamsters in dosages ranging from 100 to 700 r affected both histological normality of the reproductive system and the litter sizes. Exposures of 700 and 300 r resulted in nearly complete annihilation of the developing follicles leaving primarily egg nests and occasional primordial follicles. Connective tissue infiltration was widespread throughout all reproductive tissues, the degree dependent on the dosages employed. Exposures of 100 r, either initially only or for six successive matings, produced a comparable picture in the ovaries and accessory reproductive tissues. For females receiving only the initial 300- or 100-r exposure, sufficient normal development of follicles enabled reproduction to occur but at the rate of one or two young per litter compared with the normal litter size of 8 to 10. (auth)

23345 SYNDROMES AFFECTING REPRODUCTION IN NORMAL AND X-IRRADIATED FEMALE BEAGLES. A. C. Andersen (Univ. of California, Davis). p.377-91 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

Aging syndromes that inherently decrease reproductive capability were compared in normal and irradiated beagle dogs. The 354 purebred female beagles used were exposed to x irradiation between 10 and 12 months of age. Exposures were bilateral and given without narcotics or anesthetics; all control dogs were sham exposed. The beagles were examined regularly at intervals of 10 to 14 days postirradiation. Examinations covered: body weight, stage of estrous cycle, general appearance, and visible defects, including such syndromes as dermatoses, and skin and mammary tumors. Approximately one-half of the dogs were placed in a reproductive program designed to test their ability to whelp two litters before four years of age. Of these, 72% whelped two litters, the rest either failing to conceive or whelping only one litter. Normal ovarian development in the beagle is described. Long-term effects of x irradiation on the reproductive system are described for the ovary, uterus, and mammary glands. (H.M.G.)

23346 INFLUENCE OF OVARIAN IRRADIATION ON URINARY ESTROGENS IN BREAST CANCER PATIENTS. E. Diczfalusy, G. Notter, and R. Nissen-Meyer (Karolinski Institutet, Stockholm and Norske Radium Hospital, Oslo). p.393-400 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

Adequate ovarian irradiation of normally menstruating women substantially reduces urinary estrogen excretion. These estrogen levels cannot be reduced any further by the subsequent removal of the irradiated ovaries, but can be virtually completely eliminated following subsequent bilateral adrenalectomy. Also in postmenopausal women ovarian irradiation results in a marked reduction of urinary estrone excretion. This diminished excretion can be further reduced, or perhaps completely eliminated, by the administration of substitution doses of corticosteroids to such patients. Thus a relatively minor intervention consisting of ovarian irradiation plus corticosteroid therapy seems to yield urinary estrogen values as low as those found following a major intervention consisting of bilateral ovariectomy and adrenalectomy. (auth)

23347 THE INFLUENCE OF GONADECTOMY, SEX AND STRAIN UPON THE SURVIVAL TIMES OF X-IRRADIATED MICE. Seymour Katsh and Abraham Edelmann (Univ. of Colorado, Denver and Nuclear Science and Engineering Corp., Pittsburgh). p.427-31 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

Intact and castrated male and female mice of the KL and C57 strains were exposed to 800 r total-body x radiation. Intact females have significantly longer mean survival times than intact males (23 days vs 16 days for KL females and males, respectively, and 20 days vs 13 days for the C57 females and males, respectively). Ovariectomized animals have significantly reduced survival times (by 10 days and 6 days for the KL and C57 strains, respectively) compared with the intact females of the same strain. Orchiectomized KL males live significantly longer (by 8 days) than their intact counterparts but similarly operated C57 males were not found to survive significantly longer than unoperated C57 males. The findings are discussed from the point of view of the endocrine status of the animals. (auth)

23348 THE EFFECTS OF IONIZING RADIATION ON THE BIOSYNTHESIS AND BIOTRANSFORMATION OF CORTICOSTEROIDS. David L. Berliner, Walter Stevens, and Martha L. Berliner (Univ. of Utah, Salt Lake City). p.433-49 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

Concepts of the production, peripheral metabolism, function, and excretion of corticosteroids are discussed and effects of x radiation on these systems are considered.

Origin of the steroids, all of which are produced by genital ridge-derived glands from two carbon atoms (acetate) is illustrated. Methods for determining corticosteroids are evaluated. A common feature of the effects of ionizing radiation in all these enzyme systems was found at the cofactor level. It is suggested that most facets of the radiation syndrome might possibly be explained by an imbalance or lack of availability of cofactors necessary for the normal functioning of cells. Hence radiation could be producing a coenzyme disease. (H.M.G.)

23349 CANCER INDUCED BY SINGLE DOSES OF IRRADIATION OR AROMATIC HYDROCARBONS IN VULNERABLE TISSUES. Charles Huggins (Univ. of Chicago). p.463-6 of "Effects of Ionizing Radiation on the Reproductive System." Oxford, Pergamon Press, 1964.

Experiments involving cancer induction in rodent mammary glands and ovaries by carcinogenic hydrocarbons or ionizing radiation are examined. In the Sprague-Dawley rats both carcinogenic hydrocarbons and ionizing radiation induced a significant incidence of mammary tumors, but radioinduced ovarian cancer was rare and ovarian cancer induced by hydrocarbons nonexistent. Both mammary and ovarian tumors arise spontaneously in mice of several strains. In such mice a single shot of aromatics or irradiation induces both mammary and ovarian cancer. It appears that only those organs susceptible to the development of spontaneous cancer are susceptible to the action of appropriate aromatics or ionizing radiation. (H.M.G.)

Radiation Effects Therapy and Countermeasures

23350 (ANL-6823(p.105-8)) PROGRESS REPORT: PLUTONIUM REMOVAL. VII. EFFECT OF DTPA THERAPY AFTER 30 AND 80 DAYS ON THE REMOVAL OF MONOMERIC PLUTONIUM FROM BONE AND LIVER. Joan F. Markley, Marcia W. Rosenthal, and Arthur Lindenbaum (Argonne National Lab., Ill.).

The effectiveness of diethylenetriaminepentaacetic acid (DTPA) in reducing Pu levels in mouse bone and liver was tested. The distribution in bone and liver three days after injection of Pu was typical of that previously obtained with a monomeric solution. Thirty days after Pu injection and 18 days of DPTA treatment the liver Pu content was low and the bone content relatively high. (H.M.G.)

23351 (ANL-6823(p.114-15)) PROGRESS REPORT: PLUTONIUM REMOVAL. TUMOR INCIDENCE STUDIES. [PART] V. Marcia W. Rosenthal, Joan F. Markley, and Arthur Lindenbaum (Argonne National Lab., Ill.).

Significant developments between 400 and 650 days following monomeric Pu injection in mice are summarized. About four-fifths of the mice had at least one malignant tumor at death. Diethylenetriaminepentaacetic acid (DTPA) therapy either at 1 hr or 3 days significantly prolonged survival but not to the level of controls receiving only DTPA. (H.M.G.)

23352 (NP-13918(p.28-41)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. III. INFLUENCE OF STEROIDS AND OTHER FACTORS ON THE DEVELOPMENT OF RADIATION SENSITIVE DETOXIFICATION SYSTEMS. Kenneth P. DuBois and Florence Kinoshita (Chicago. Univ. Air Force Radiation Lab.).

Factors influencing the activity of a radiation-sensitive enzyme system that catalyzes the detoxification of O,O-diethyl O-(methylthio-*m*-tolyl) phosphorothioate (DMP) were investigated. The effects of single and repeated doses of steroids were tested on the development of resistance to DMP in weanling male rats and adult females. The influence of radiation on the development of the enzyme activity was also tested. The influence of daily injections of testosterone, methyltestosterone, progesterone, desoxycorticosterone, cortisone (2 mg/kg/day) and diethylstilbestrol (0.5 mg/kg/day) on the resistance of adult female rats to DMP was tested by comparing the amount of inhibition of the cholinesterase in various tissues after administration of 15 mg/kg of DMP to the treated animals and controls. Prolonged treatment with all of these steroids for 3 or 4 weeks markedly increased the resistance of the animals to DMP. During the course of experiments involving prolonged treatment with steroids it was noted that 24 hr after the first dose an appreciable amount of resistance was acquired. Additional experiments with progesterone and testosterone showed that considerable resistance developed during a period of 3 to 5 days after a single dose of each compound indicating induction of enzyme activity similar to that obtained by single doses of various other chemical agents. Measurements were made on the rate of development of the detoxification mechanism in the livers of castrated, weanling male rats and the effects of steroids and x irradiation on this process. Testosterone, progesterone, and estradiol markedly stimulated the development of resistance. Exposure of the castrated animals to 400 r of x ray greatly inhibited the stimulation of development of the detoxification system produced by testosterone. (auth)

23353 (NP-13918(p.42-57)) PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. I. EFFECTS OF 2-IMINO-THIAZOLIDINE-4-CARBOXYLIC ACID ON THE RADIOPROTECTIVE ACTIVITY OF VARIOUS CHEMICAL AGENTS. J. Dilley and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

Combinations of 2-imino-thiazolidine-4-carboxylic acid and prophylactic radioprotective agents such as mercaptoethylamine (MEA), aminoisothiourea (AET) and *p*-aminopropiophenone (PAPP) were tested for additive effects against radiation lethality in x-rayed mice. When the thiazolidine derivative was given 30 min following whole-body x ray exposure, additive protective effects were seen generally in the animals pretreated with AET but not in those pretreated with PAPP. The post-irradiation administration of thiazolidine to mice given MEA prior to the x-ray exposure decreased the protective effect after 800 r but increased the effect of MEA in animals exposed to either 1000 or 1200 r. The administration of the thiazolidine derivative prior to the administration of the prophylactic radioprotective agents was generally less effective than post-irradiation administration of this agent except in the case of the PAPP-treated mice where the combination increased the 30-day survival from 19% (PAPP only) to 70% (PAPP + 2-IT). Incubation of the thiazolidine derivative with *d*-amino acid oxidase preparation obtained from dog kidneys failed to indicate metabolic conversion as measured by oxygen uptake measurements. However, the thiazolidine derivative as well as PAPP significantly inhibited the activity of the enzyme preparation when valine was used as the substrate. (auth)

23354 (NP-13918(p.58-74)) PHARMACOLOGICAL OR TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN

EXPERIMENTAL ANIMALS. II. THE INFLUENCE OF VARIOUS CHEMICAL COMPOUNDS ON RADIATION LETHALITY IN MICE. V. Plzak, M. Root, and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

Twenty-three compounds were evaluated for protective activity against radiation lethality in CF_1 male mice. Of these, 16 were significantly radioprotective against a lethal dose of whole-body x irradiation, as evidenced by the fact that over 20% of the mice so pretreated survived for at least 30 days after the exposure. (C.H.)

23355 (NP-13918(p.75-98)) PHARMACOLOGICAL OR TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. III. DOSE-MORTALITY RELATIONSHIPS FOR SEVERAL RADIOPROTECTIVE AGENTS. J. Doull, V. Plzak, and D. G. Oldfield (Chicago. Univ. Air Force Radiation Lab.).

Studies were carried out to compare the ability of various radioprotective agents to reduce the effective administered x ray dose in CF_1 male mice. For these studies agents which had previously been shown to exhibit some protective activity were given prior to a series of x-ray exposures and the 30-day mortality data used to determine the dose reduction factor (DRF) for each compound. The calculations were based on an analysis of the maximum likelihood estimates of the 30-day mean lethal x-ray dose and other parameters, and were performed by IBM 7094. The results of these studies indicate that 2,2′-dithio-bis-(ethylamine) (CB-34) is somewhat more effective in reducing radiation lethality in x-rayed mice than the related agent mercaptoethylamine (DRF of 1.68 vs 1.42). The protective activity of 2-butanone oxime (EK-906), 2-methyl-2-thiopseudourea (EK-1231). 2-amino-5-mercapto-1,3,4-thiadiazole (FA-6), and SC-23 were similar (DRF of about 1.3) while that of glyoxal (EK-T-4435, DRF of 1.1) and 3-amino-9-ethyl-carbazole (K-3132, DRF of about 1) was of borderline significance. Although protective effects were observed following the administration of SC-19, GE-17, and GE-16, these were not of sufficient magnitude to permit analysis by the methods employed for the present studies. (auth)

23356 (NP-13918(p.99-106)) PHARMACOLOGICAL OR TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. IV. FURTHER STUDIES ON THE ROLE OF SODIUM NITRITE IN RADIOPROTECTION IN MICE. A. T. Hasegawa and H. D. Landahl (Chicago. Univ. Air Force Radiation Lab.).

Intravenous administration of 200 mg/kg of sodium nitrite reduced the spleen oxygen tension in irradiated mice to 13% of normal within 8 to 10 min. The LD_{50} for mice irradiated eight min after the intravenous injection of sodium nitrite (200 mg/kg) was 1260 r giving a dose reduction factor of 2.2. Administration of methylene blue to sodium nitrite-treated mice not only reduced the methemoglobin concentrations, but also decreased substantially the nitrite levels in the blood. The methemoglobin concentration and the nitrite levels measured in animals kept in an atmosphere of 100% oxygen for 20 min after sodium nitrite injection did not differ importantly from those of the animals kept in room air. However, the spleen oxygen tension of the first group was maintained close to normal values instead of being about 35% of normal in the animals breathing air. Measurements of oxygen tension in the vena cava indicated a substantial decreased level at 20 min after nitrite injection while breathing 100% oxygen. Preliminary studies on radioprotection indicate that some protection is lost when the animals are kept in an atmosphere of 100% oxygen for a 22-min period immediately after nitrite injection through the x-ray exposure. (auth)

23357 (NP-13918(p.107-15)) INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON EXPOSURE ON THE LIFE SPAN OF ANIMALS. I. CHEMICAL RADIOPROTECTION AGAINST ABSORBER-MODERATED PROTONS. D. G. Oldfield, V. Plzak, and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

Radioprotection in adult CF_1 male mice pre-treated with *p*-aminopropiophenone (PAPP) and then total-body irradiated at depths in a Masonite phantom corresponding to nominal proton energies of 440, 350, 250, and 150 Mev was measured. Computer probit analysis of 30-day mortality data gave dose reduction factors of (710/503) = 1.41 at 440 Mev, (847/537) = 1.58 at 350 Mev, (908/583) = 1.56 at 250 Mev, and (702/503) = 1.40 at 150 Mev (all doses in rads). rads). Comparing the above values with the values (1260/849) = 1.41 for unmoderated 440-Mev protons and with (560/875) = 1.56 for 250-kvp x rays, obtained in previous runs, it would appear that radioprotection by PAPP at the dosage levels used is not strongly energy- or particle type-dependent in the ranges of these parameters studied thus far. (auth)

23358 (NP-13918(p.116-28)) INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS. II. EFFECT OF THE ADDITION OF 2-MERCAPTOETHYLAMINE OR PARA-AMINOPROPIOPHENONE TO THE DIETS OF CHRONICALLY IRRADIATED MICE AND THE PRODUCTION OF METHEMOGLOBIN BY FEEDING A DIET CONTAINING PARA-AMINOPROPIOPHENONE. A. Sandberg and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

Feeding studies in which *p*-aminopropiophenone (PAPP) or 2-mercaptoethylamine (MEA) was added to the diet of CF_1 female mice indicated that these animals could tolerate doses of PAPP and MEA as high as 0.1% for at least a period of 20 weeks before a marked decrease in survival became apparent. Animals provided with a diet containing 0.1% PAPP and 0.5 MEA exhibit a decreased survival when exposed to 54 r/day gamma irradiation as compared to mice maintained on a control diet and exposed to 54 r/day. It is not possible to achieve levels of methemoglobin as high as those obtained by PAPP injection by the addition of PAPP to the diet. The methamoglobin levels do not increase greatly when the drug is ingested for a period of six weeks. If animals are exposed to 100 r/day of x ray for a period of 13 days and fed a PAPP-containing diet, the methemoglobin levels are 3.5 times as great as the methemoglobin levels of mice which received only PAPP in the diet. The feeding of a diet containing PAPP produces splenic enlargement which is inhibited if 100 r/day x ray is administered. (auth)

23359 (JPRS-24593(p.120-5)) THE PROTECTIVE EFFECT OF STREPTOMYCIN ON CHROMOSOMES OF REPRODUCTIVE CELLS AGAINST RADIATION DAMAGE IN MAMMALS. Shao Wei, Tu-kung Wang, and Chang Han. Translated from K'o Hsueh T-ung Pao. No. 2, 169-70 (1964).

The protective effect of a low concentration of streptomycin on reproductive chromosomes against radiation damage in albino mice was observed. Eight hours prior to irradiation, 0.2 ml of physiological solutions containing various concentrations of streptomycin was injected intraperitoneally into mice. X-ray doses were 150 r at 31 r/min. The rate of chromosome deformity at 15 hr after irradiation was 10.4%, at 38 hr it was 9.18%, whereas in unirradiated testes chromosome deformity was only 0.13%. At low streptomycin concentrations (0.5 mg) an apparent decrease in the chromosome deformity rate was manifested. At 16 hr after irradiation the protective effect was found to reach 63.8%. When 1 mg of streptomycin was used, a protective effect of 50.6% was observed. As the streptomycin was further increased (3 to 5 mg), no apparent protective effect was observed. In mice receiving streptomycin with no radiation, changes in chromosome deformity were not apparent. However, as the streptomycin concentration was increased to 5 mg and above, the specimen fixed at 46 hr after irradiation showed an apparent increase in chromosome deformity rate. (M.C.G.)

23360 (JPRS-24704(p.1-5)) CAUSES OF THE PROTECTIVE EFFECT PRODUCED BY BACTERIAL ANTIGENS IN ACUTE RADIATION SICKNESS. M. I. Ravich-Shcherbo and L. G. Prokopenko. Translated from Byul. Eksperim. Biol. i Med., 56: 36-8(1963).

The protective effect of bacterial antigens in radiation sickness was investigated in rabbits injected with Bacillus paracoli cells 48 hr before irradiation and immunized with human blood serum protein. Results showed that the protective effect of preliminary immunization developed in the lymph nodes that elaborated antibodies to the antigens introduced prior to irradiation. It is suggested that stimulation of the production of plasmocytes may be involved. (C.H.)

23361 (JPRS-24817) RESEARCH ON RADIATION SICKNESS AND PROTECTIVE MEASURES. Translated from Farmak. i Toksikol. 27: 73-82(1964). 18p. (OTS-64-31356)

Separate abstracts were prepared on three sections of this report. (C.H.)

For abstracts of individual sections see: 23362, 23363, and 23364.

23362 (JPRS-24817(p.1-8)) RADIOPROTECTIVE PROPERTIES OF NEUROTROPIC PHARMACOLOGICAL AGENTS OF THE ANTIFEINE GROUP. A. M. Stashkov and V. P. Korotkova. Translated from Farmak. i Toksikol., 27: 73-6(1964).

The protective effects of several diamide derivatives of imidazoledicarboxylic acids against radiation injury were investigated in mice, rats, rabbits, and dogs exposed to doses of x radiation ranging from 500 to 1000 r. The animals were observed for 30 to 45 days and the protective effects of the compounds were evaluated on the basis of survival, peripheral blood picture, weight change, and the general condition of the animals. Functional changes in reticular formation and the area of the hypothalamus were also studied in rabbits by electroencephalographic methods. The compounds evaluated included antifeine, ethylnorantifeine, and allylnorantifeine. Antifeine was found to be effective when administered 30 min prior to exposure to doses of 700 r. The protective action was limited to this radiation dose range and to specific doses of the protective compound. The protective dose was toxic in mice. The pharmacological action of the compounds appeared to be linked to central nervous system activity. (C.H.)

23363 (JPRS-24817(p.9-14)) THE EFFECT OF AMINASINE, PROMEDOL AND DIMEDROL ON THE DURATION OF BARBAMYL INDUCED SLEEP IN HEALTHY ANIMALS AND UNDER CONDITIONS OF EXPERIMENTALLY PRODUCED RADIATION SICKNESS. Yu. Ya. Saydakovskii. Translated from Farmak. i Toksikol., 27: 77-80(1964).

Results are reported from studies on the effects of mixtures of aminasine, promedol, and dimedrol on the duration of barbamyl-induced sleep in healthy and irradiated rats. The mixtures prolonged the sleep-inducing action of barbamyl in both irradiated and healthy animals. The duration of barbamyl-induced sleep was noticeably reduced in rats during the acute phase of radiation sickness. (C.H.)

23364 (JPRS-24817(p.15-17)) RADIOPROTECTIVE PROPERTIES OF CERTAIN ISOTHIURONIC DERIVATIVES OF PYRIDOXINE. A. F. Mosin. Translated from Farmak. i Toksikol., 27: 81-2(1964).

The protective effects of certain isothiuronic derivatives of pyridoxine against radiation injury were evaluated in rats, rabbits, and dogs. The survival rate was increased by 5-isothiuronic pyridoxine. Structural formulas are included for the compounds tested. (C.H.)

23365 THERAPY OF LETHAL RADIATION INJURY WITH NICOTINIC ACID DERIVATIVES. I. EXPERIMENTAL INVESTIGATION OF THE ACTION OF 7-[2-HYDROXY-3-(N-2-HYDROXYETHYL-N-METHYLAMINO) PROPYL]-1,3-DIMETHYLXANTHINE-PYRIDINE-3-CARBOXYLATE BEFORE AND AFTER LETHAL WHOLE-BODY IRRADIATION OF THE WHITE MOUSE. Gunther Barth and Walter Kern (Justus-Liebig Universität, Giessen, Ger.). Arzneimittel-Forsch., 13: 726-8(Aug. 1963). (In German)

The xanthine derivative, Complamin, 7-[2-hydroxy-3-(N-hydroxyethyl-N-methylamino)propyl]-1,3-dimethylxanthine-pyridine-3-carboxylate, was used for treatment of 426 mice exposed to 650 r of whole-body x radiation. The basis for use of this compound was its vasodilator effect to increase tissue O concentrations, and its ability to release β-pyridine-carboxylic acid, a constituent of diphosphopyridine nucleotide (DPN). Synthesis of DPN decreases rapidly under conditions of tissue anoxia associated with the effects of x radiation. The LD$_{50}$ of Complamin in mice is 510 mg/kg body weight intravenously and 1740 mg/kg body weight intraperitoneally. A 30-day survival rate of 80 to 95% in individual groups was found after intravenous administration of this drug during the first hr after radiation exposure. The dosages given consisted of single injections of 0.006, 1, or 15 mg, and 12 injections of 0.002 mg. A marked leukopenia was noted in both control and treated animals two days after the radiation exposure. The results of this study may have clinical application to patients who are undergoing radiation therapy. Tolerance to the radiation is increased if this radiation protection agent is administered along with the radiation therapy. (BBB)

23366 PARTICULAR FEATURES OF THE COURSE OF RADIATION SICKNESS IN MICE SUBJECTED TO TREATMENT WITH BONE MARROW AND TO IMMUNIZATION. O. P. Lebedeva and N. A. Maksimovich (Inst. of Infectious Diseases, Kiev). Dokl. Akad. Nauk SSSR, 155: 454-6(Mar. 11, 1964). (In Russian)

A total of 600 mice of the inbred BALB line were given a whole-body, x-ray dose of 600 r. Some of the mice were immunized with a flu virus vaccine A-PR$_8$. A suspension of bone marrow cells was administered intravenously to part of the mice one hour after the irradiation. The survival was determined on the 4th, 8th, 12th, and 16th day after irradiation. Only 2 out of 60 mice survived in the group that was not treated with bone marrow. On treating the irradiated mice with doses of 80 and 10 million blood cells, the survivals were 12 out of 14, and 12 out of 13 mice, respectively. Immunization decreased the effectiveness of the bone marrow treatment. With a transfusion of 80 million blood cells, less than half of the immunized mice survived, while $^2/_3$ of the immunized mice survived on decreasing the dose of bone marrow cells to 10 million cells. Leucopoesis was suppressed by the irradiation, but the transfusion of bone marrow cells stimulated leucopoesis by a factor of 2 to 3. The histopathological organ changes in the liver and spleen were typical of severe radiation sickness with bleeding and tissue breakdown being observed even on the 10th to 12th day after the irradiation. Tissue recovery in the spleen was observed on the 6th to 8th day after irradiation in the mice treated with a transfusion of bone marrow cells. (TTT)

23367 REACTIVATION OF X-IRRADIATED MOUSE L CELLS BY MEANS OF CELLULAR FRACTIONS AND HIGHLY POLYMERIZED DEOXYRIBONUCLEIC ACID. M. Horikawa, T. Sugahara, and Y. Doida (Kyoto Univ.). Exptl. Cell Res., 34: 198-200(Mar. 1964).

X-irradiated mouse L cells were treated with various fractions of cells and with highly polymerized DNA and RNA prepared from various unirradiated cells. Reactivation phenomena were observed in cells treated with homogenates of L cells and, to a lesser extent, in cells treated with nuclei and DNA isolated from L cells and DNA from salmon sperm. The recovery phenomena were not observed in irradiated cells treated with L cell-RNA and yeast RNA. (C.H.)

23368 RADIOPROTECTIVE EFFECTS OF ALKALINE EARTH CHLORIDES ($BeCl_2$, $SrCl_2$ AND $BaCl_2$) ON GROWTH OF BARLEY. C. Gillet, G. Lennes, and Z. M. Bacq (Université, Liege). Intern. J. Radiation Biol., 7: 395-9(Oct. 1963). (In French)

It is in contrast to experiments with distilled water that 0.5M solutions of $BeCl_2$, $SrCl_2$, and $BaCl_2$, in which barley grains were submersed before irradiation, bring about radioprotection for coleoptile and first-leaf growth (as do solutions of the other alkaline-earth chlorides). This result is discussed in terms of osmotic pressure and of the biological properties of the tested ions. (tr-auth)

23369 REMOVAL OF POLYMERIC PLUTONIUM FROM MICE BY COMBINED THERAPY WITH THE CALCIUM CHELATE AND PENTA-ETHYL ESTER OF DTPA. Joan F. Markley (Argonne National Lab., Ill.). Intern. J. Radiation Biol., 7: 405-7(Oct. 1963).

Diethylenetriaminepentaacetic acid (DTPA) ethyl ester, Ca DPTA, or both were administered to CF1 female mice injected previously with 0.092 μC polymeric ^{239}Pu. Livers, spleens, and femurs were analyzed for Pu content by α-activity counting. Plutonium levels were lowered in the liver and bone by Ca DTPA and in liver by DTPA ester. Combined use of Ca DTPA and DTPA ester lowered Pu levels in the spleen, whereas the use of either singly raised splenic Pu levels, indicating that some of the Pu removed from the liver was redeposited in the spleen. (H.M.G.)

23370 3-ALKYL-1,3-THIAZANE DERIVATIVES AND PRECURSORS AS ANTIRADIATION AGENTS. E. Campaigne and P. K. Nargund (Indiana Univ., Bloomington), J. Med. Chem., 7: 132-5(Mar. 1964).

Radioprotective effects were found in 3-(β-aminoethyl)-1,3-thiazane-2,4-dione hydrochloride and 1,3-thiazane-2,4-dione. Attempts were made to synthesize and test a series of 3-alkyl-1,3-thiazane-2,4-diones and 3-alkyl-1,3-thiazone-2-thione-4-ones as potential antiradiation compounds. 1,3-Thiazane-2,4-diones were prepared by treatment of alkylamines with carbon disulfide in alkali, followed by reaction of the resulting alkyldithiocarbamate salts with β-propiolactone. The desired products were then prepared by the ring closure of the obtained β-alkylcarbamoylmercaptopropionic acids and β-alkylthiocarbamoylmercaptopropionic acids. It was expected that both these propionic acids should have zwitterionic structures, but β-(2-diethylaminoethylthiocarbamoyl)mercaptopropionic acid dihydrate showed unionized carboxyl carbonyl absorption at 5.83 μ in the infrared spectrum, indicating a nonzwitterionic structure. As expected, β-(3-diethylaminopropylthiocarbamoyl)mercaptopropionic acid hydrate showed the absence of unionized carboxyl carbonyl absorption at 5.8 to 5.9 μ and the presence of ionized carboxyl carbonyl absorption at 6.36 μ, indicating the zwitterionic structure in this case. 3-Alkyl-1,3-thiazane-2-thione-4-ones were generally prepared by the ring closure of β-alkylthiocarbamoylmercaptopropionic acids with acetic anhydride, using a small amount of concentrated sulfuric acid. However, when β-n-butylcarbamoylmercaptopropionic acid was treated with acetic anhydride to effect cyclization, β-N-(n-butyl)-N-acetylcarbamoylmercaptopropionic acid was obtained. Therefore most of the β-alkylcarbamoylmercaptopropionic acids were cyclized to their corresponding thiazanediones by using thionyl chloride. Twenty propionic acids were prepared and their physical constants are listed. Fifteen thiazane derivates and their physical properties are also described. Tests for the ability of some of these compounds to protect mice against x irradiation were carried out, but none showed activity in mice irradiated with 825 r. Slight protection was afforded by 1,3-thiazane-2,4-dione at 525 r. (BBB)

23371 RADIATION PROTECTION EFFECTS OF CHLOROTRIANISE. Kurt Flemming (Heiligenberg-Instituts, Heiligenberg, Ger. and Universität, Freiburg i. B.). Naturwissenschaften, 51: 59-60(1964). (In German)

Chlorotrianise was administered to mice before x-ray irradiation and the survival rate was determined. Two mg chlorotrianise injected 10 days before irradiation exerted a strong radioprotective effect in the case of sublethal radiation doses. Two to 3 mg showed protective effects if they were injected in several small doses of 0.5 mg/day. (M.C.G.)

23372 THE PROTECTIVE ACTION OF ESCULIN (ACIDUM AESCULINICUM) IN EXPERIMENTAL RADIATION SICKNESS IN RABBITS. Nauchn. Tr. Visshiya Med. Inst., Sofiya, 41: No. 4, 91-7(1962).

The protective action of esculin was tested on 72 rabbits that had received roentgen radiation doses of 300 r in three days, 800 r in one day, or 600 r in one day. Sponges were saturated with aqueous solutions of various concentrations of esculin and applied to the target skin areas prior to irradiation. In the control experiments, water-saturated sponges were used. The best results were obtained with a 20% solution in rabbits that had received 800 r. As compared to the control group, the death rate in this group of animals dropped by 15.5%. Leukopenia in the latter group was less pronounced and more rapidly corrected than in the controls. A 10% solution did not protect the animals from roentgen irradiation. The assumption is that the protective effect of esculin is related to the phenomenon of photoreactivity. (OTS)

23373 EXPERIMENTAL STUDIES OF THE EFFECT OF THEOPHYLLINE ASSOCIATED WITH SODIUM NUCLEINATE (NUCLEVASAN) ON LEUKOPENIA IN RADIATION DISEASE IN RABBITS. V. Todorov (Higher Medical Inst., Sofia). Nauchni Tr. Visshiya Med. Inst. Sofiya, 42: 147-56(1963). (In Bulgarian)

A complex prepared from theophylline and nucleic acid was injected daily for seven days in rabbits previously irradiated with 800 r. The mortality rate was reduced to 10%, compared to 57% in controls, and total and differential blood leukocyte counts were normalized by the end of the seven-day treatment period. (BBB)

23374 INVESTIGATION OF RADIATION PROTECTION OF PLANT CELLS. II. PROTECTIVE EFFECTS OF VARIOUS MATERIALS AGAINST ALPHA RADIATION IN PRE- AND POST-TREATMENT. Richard Biebl and Walter Url (Universitat, Vienna). Protoplasma, 56: 670-700(1963). (In German)

Alpha-particle effects on the red external epidermis of onion (Allium cepa) bulbs were studied after pretreatment and post-treatment with various materials. It was possible to distinguish between chemical radiation protection in pretreatment and therapeutic effects in post-treatment. The outer layers of the epidermis were more resistant to alpha particles than the inner layers. In irradiations of up to 105 min, 0.25 μ thioacetamide had the maximum protective action after 1-hr pretreatment. Protective effects were also observed with methylallylisothiourea, N-acelylthiourea, thiourea, and urea in decreasing order. S-β-aminoethylisothiourea, methylthiourea, tetramethylthiourea, sodium azide, and sodium thioglycolate also showed some protective effects. Treatment with these compounds after irradiation showed no therapeutic effects and in some cases were toxic to the cells. Glucose, fructose, sucrose, glycerol, pentaerythritol, and calcium chloride had no protective effects in pretreatment, but showed therapeutic effects when applied after irradiation. It was concluded that the therapeutic compounds modified colloidal changes in the proteins produced by alpha particles, while the protective compounds probably combined with toxic materials produced by radiation. (M.C.G.)

23375 RESTORATION OF HOMOLOGOUS MONKEY HEART CELLS FOLLOWING IRRADIATION. I. M. Pakhomenko (Moscow State Univ.). Radiobiologiya, 3: 689-90(1963). (In Russian)

Recovery from lethal injuries in homologous tissue culture cells was attempted using phosphate buffer. It was found that 1 to 2 hr incubation inhibits proliferation of cells (35.1 to 25%) while 8 hr incubation improved the level of proliferation from 74 to 78%. (R.V.J.)

23376 STIMULATING EFFECTS OF SEROTONIN ON HEMATOPOIETIC SYSTEM IN IRRADIATED RATS. E. Ch. Pukhal'skaya and A. S. Lyufachun (Inst. of Experimental and Clinical Oncology, Moscow). Radiobiologiya, 3: 703-10(1963). (In Russian)

Continuous applications of serotonin results in increased peripheral blood in nuclear neutrophils in rats. Systematic serotonin injection in rats exposed to large-dose whole-body irradiation resulted in amplified and accelerated regeneration of myeloid elements in white blood and to a lesser degree in thrombocytes. Applications of serotonin simultaneously with local x-ray therapy induce a rapid restoration of leukocytic level. It is suggested that a course of serotonin injections may sensitize bone marrow to x radiation. (R.V.J.)

23377 NEURO-ENDOCRINE REACTION TO MERCAMINE AND ANTIFFEINE AND IRRADIATION. V. E. Ryzhenkov, A. M. Stashkov, and V. P. Korotkova (Inst. of Experimental Medicine, Leningrad). Radiobiologiya, 3: 716-20(1963). (In Russian)

Responses of the nervous system and adrenocortical-hypophysis function to radioprotective chemicals (mercamine and antiffeine) and to x radiation were studied in 26 rabbits and 8 dogs. Electroencephalographic studies showed an increased functional activity of the hypothalamic region and of the ascending reticular formation of the mesencephalon in rabbits 10 to 50 min after injections with 15 to 25 mg of antiffeine and 100 mg of mercamine per kg of body weight. Injections of mercamine (75 mg/kg) and antiffeine (15 mg/kg) into dogs increased the content of 17-oxycortical steroids in the peripheral blood by 3 to 4 folds 1 to 1.5 hr after the injections. A simultaneously developed eosinopenic reaction indicated an increased adrenocortical-physico function. Preliminary activation of neuro-humoral mechanisms by mercamine and antiffeine depressed radiation injuries. Whole-body irradiation of rabbits treated with 0.8 to 1 g/kg of uretion enhanced radiation injuries with fatal results. (R.V.J.)

23378 RADIATION PROTECTION OF PHENOXAZINE DERIVATIVES. V. N Benevolenskii and A. I Zhuravlev Radiobiologiya, 3: 745-8(1963). (In Russian)

Antioxidation effects and radiation protection of 22 phenoxazine derivatives were studied using oleic acid, neutral fat, and Saccharomyces vini yeast cells. The experiments showed that β-mercaptoethyl urea, phenoxazine, and 1-chloracetylaminophenoxazine have prophylactic effects on cells, but are not as effective as free cysteine. The examined synthesized substances were divided into three groups: an oxidation inhibiting group, which depressed oxidation in oleic acid and in neutral fat; antioxidant substances for oleic acid and catalyst for neutral fat; and catalyst for oleic acid and neutral fat oxidation. In addition to phenoxazine only the first group of active antioxidants exhibited protective effects for yeast cells. (R.V.J.)

23379 COMPARATIVE ACTIVITY OF SOME RADIOPROTECTORS FOR VICIA FABA SEEDLING ROOTS. L. I. Tank. Radiobiologiya, 3: 749-53(1963). (In Russian)

Radioprotective effects of 3 mercamine salts, cystamine, S,β-aminoethylisothiuronium, β-mercaptoethylguanidine disulfide, diethyldithiocarbamic acid sodium salts, 5 mercaptopentylamine, and S-ethylisothiuronium, on Vicia faba, seedling roots were compared. (R.V.J.)

23380 INFLUENCE OF INACTIVATION ON PROTECTIVE PROPERTIES OF CERTAIN ANTIBIOTICS. A. Kh. Tambiev and V. G. Bulgakova (Moscow State Univ.). Radiobiologiya, 3: 754-7(1963). (In Russian)

Inactivation of bactericidic and bacteriostatic properties of antibiotics do not interfere with their radioprotective properties in yeast. However, inactivated antibiotics (tetracycline, oxytetracycline, and biomycine) lose a great deal of their protective potency against radiation damage in mice. In the activated state the same antibiotics have a strong protective effect against post-irradiation infections. (R.V.J.)

23381 EFFECTS OF MONOMERS OF γ IRRADIATED ERYTHROCYTES IN MAN. T. N. Kalabukhova and Yu. P. Kozlov (Moscow State Univ.). Radiobiologiya, 3: 758-61 (1963). (In Russian)

Protective properties of monomer solutions (vinylpyrrolidone and acrylamide) against radiation effects in erythrocytes are the result of a polymerization process. The monomer toxicity is related to their penetration into erythrocytes and subsequent participation in intra-cellular metabolism. (R.V.J.)

23382 EFFECTS OF UNITHIOL ON EXCRETION OF CHEMICAL COMPOUNDS IN URINE OF RATS INJURED BY Po^{210}. M. S. Uspenskaya and A. G. Izergina. Radiobiologiya, 3: 762-5(1963). (In Russian)

Acute radiation sickness induced by Po^{210} (0.1 μC/kg) injections into rats affected the DNA metabolism and increased deoxycytidine excretion in urine on the 1st to 3rd day after the injection. Treatments with 100 mg/kg doses of unithiol 2 to 3 times a day for 30 days prevented the excessive excretion of deoxycytidine. (R.V.J.)

23383 EFFECTS OF CYTOCHROME C ON RADIOPROTECTIVE PROPERTIES OF CARBON OXIDE. L. A. Tiunov and G. A. Vasil'ev. Radiobiologiya, 3: 766-9(1963). (In Russian)

It was found that 8 mg/kg of cytochrome C does not interfere with the prophylactic effects of CO against x radiation. Intraperitoneal injections of cytochrome C into white rats 15 min before or after exposure to 730 to 750 r of x radiation did not effect the survival of rats. (R.V.J.)

23384 ON THE MECHANISM OF THE THERAPEUTIC EFFECTS OF PROCAINE IN ACUTE RADIATION SICKNESS. N. N. Klemparskaya and N. V. Raeva. Radiobiologiya, 3: 778-9(1963). (In Russian)

Oral administration of 0.2 ml of 0.5% procaine to 59 mice for 8 days prior to exposure to gamma radiation (500 r) resulted in 54.1% survival, with only 20% of 75 control mice survived. Procaine administration for 20 to 25 days following irradiation resulted in 68.3% survival. Administration of 3 ml of 0.5% procaine solution for 8 days before exposure of 650 r resulted in 43.5% survival; 2.3% of controls survived. Favorable effects of procaine administration were also observed in dogs and rabbits. The mechanism of the prophylactic effects is discussed. (R.V.J.)

23385 ON THE APPLICATION OF AMINO COMPOUNDS IN COMBINATION WITH THIOLS IN PRACTICE WITH ACUTE RADIATION SICKNESS. L. F. Semenov. p.58-9 of "Sbornik, Materialy Nauchnoi Konferentsii Instituta Experimental'noi Patologii i Terapii, Akademiya Meditsinskikh Nauk SSSR." Sukhumi, 1963.

The protective effect of amines in combination with thiols when subcutaneously administered to mice 5 to 10 min before the animals were subjected to gamma radiation at doses of 1050 r (LD_{100}) to 1200 r was studied. Most effective treatment was the combination of adrenaline with acetylcholine and cystamine. Sixty-seven percent of the animals survived after a dose of 1050 r as against 25 to 33% survival when the preparations were separately applied; 24% of the animals survived from 1200 r. Of the indolamines, the combination of mexamine and serotonin with cystamine or aminoethylisothiuronium (AET) exhibited the most protective action. Sixty to 70% of the animals survived after 1050 r, and 40 to 45% after 1200 r. Histamine in combination with AET produced a 40 to 48% survival of the animals exposed to 1200 r. The combination of amines with cysteamine and unithiol was also effective. (OTS)

Radiation Hazards and Protection

23386 (CONF-12-3) REMOVAL OF RADIOIODINE VAPOR FROM GASES AT ELEVATED TEMPERATURES. Robert E. Adams and William E. Browning, Jr. (Oak Ridge National Lab., Tenn.). [nd]. Contract [W-7405-eng-26]. 13p.

From the American Nuclear Society 8th Annual Meeting, Boston, June 1962.

After a survey of methods previously used for iodine removal from gas streams, it was concluded that a system employing activated charcoal would more completely satisfy the requirements of an emergency ventilation system then other methods. Iodine vapor removal from a gas stream of steam and air at 80 to 100°C was studied. The presence of water vapor was found to have a slightly deleterious effect on the iodine adsorption efficiency of charcoal. Increased temperature also lowered the iodine adsorption efficiency slightly. However, a high removal efficiency was observed for periods up to 2.75 hr and with gas velocities less than 75 ft/min. Tests of charcoal efficiency for removing iodine vapor from helium streams showed good results for temperatures as high as 430°C for up to 3 hr, but continued helium flow was found to slowly remove the iodine contained in the charcoal bed. Various types of charcoal exhibited variations in iodine removal and retention. (M.C.G.)

23387 (ISS-64/2) FATTORI DI CORREZIONE PER LA CALIBRAZIONE DI PREPARATI DI RADIO. (Correction Factors for the Calibration of Encapsulated Radium Sources). G. Castellani Poli (Italy. Istituto Superiore di Sanità, Rome). Feb. 18, 1964. 35p.

The corrections that need to be made in the calibration of encapsulated radium sources for therapeutic use are discussed. By means of accurate experimental determinations, tables were developed for the correction factors in terms of the thickness of lead screening the ionization chamber. (auth)

Radiotherapy and Radiodiagnosis

Refer also to abstract 23831.

23388 STUDY OF THE DOSE IN THE VICINITY OF THE INTERFACE BETWEEN TWO MEDIA OF DIFFERENT ATOMIC COMPOSITION EXPOSED TO X RADIATION OF 11 TO 20 Mv. J. Dutriex, A. Dutreix, M. Bernard, and A. Bethencourt (Institut Gustave-Roussy, Villejuif, France). Ann. Radiol., 7: R233-41(1964). (In French)

Near the interface between carbon and a metal irradiated with high-energy x rays, the dose shows a rapid variation of large amplitude. This variation was studied with an ionization chamber of small thickness for metals of various Z (Al to U). The numerical values obtained can be applied under the practical conditions of radiotherapy to the interface between tissue equivalent water and metal and to radiological experiments with cells or bacteria irradiated in receptacles not equivalent to water. (auth)

23389 CAESIUM 137 SOURCES FOR USE IN INTRACAVITARY AND INTERSTITIAL RADIOTHERAPY. A. F. C. Horsler (Radiochemical Centre, Amersham, Bucks, Eng.), J. C. Jones, and A. J. Stacey. Brit. J. Radiol., 37: 385-90(May 1964).

The construction and properties of ^{137}Cs sources suitable to replace Ra tubes and needles in general use are described. It is found that the exposure distribution in water around these sources is very nearly the same as that produced by their Ra equivalents. The results of a test for the presence of ^{134}Cs are given showing that the contribution of this isotope to the dose-rate is less than 6%. The relative advantages possessed by ^{137}Cs for this application are discussed. (auth)

23390 ABSOLUTE DETERMINATION OF I^{125} IN CLINICAL APPLICATIONS. James S. Eldridge and Peter Crowther (Oak Ridge National Lab., Tenn.). Nucleonics, 22: No. 6, 56-9(June 1964).

By taking advantage of the unique ^{125}I spectrum, one can determine absolute activity of this medical radioisotope with commercial detectors if their surfaces are treated to prevent distortion. (auth)

23391 THE INFLUENCE OF IONIZING RAYS ON THE SEROLOGICAL REACTIONS IN CASES OF SERUM-RESISTANT SYPHILIS. Jozefa Rubisz-Brzezinska and Boleslaw Szymczyk. Przeglad Lekar., 20: 176-9(1964). (In Polish)

On the basis of the work of Ciarocchio, the authors subjected 22 patients with serum-resistant syphilis to total irradiation (Roentgen rain). The material included cases of syphilis after many serological control examinations and exhaustive specific treatment. X-ray irradiation in this material did not make the blood serum reactions negative. The data lead to the conclusion that total irradiation with x rays is still an imperfect method of treating serum-resistant syphilis. (auth)

23392 PRELIMINARY STUDIES WITH Se-75 METHIONINE FOR CLINICAL DIAGNOSIS OF PANCREAS TUMOR. Teruo Nagai (National Inst. of Radiological Sciences, Chiba, Japan). Radioisotopes (Tokyo), 12: 378-83(Nov. 1963).

Scintillation scanning of the pancreas was studied as a clinical diagnostic method. Se^{75}-labeled selenomethionine was injected intravenously into one normal subject and five patients suspected of having pancreas cancer. Area scans, linear scans, external counting over the pancreas, and whole-body counting were performed. Visualization of the pancreas in five cases was obtained successfully. In two cases a defect of the tail image was recognized. The results showed that ^{75}Se-labeled selenomethionine might be useful for clinical diagnosis of various pancreas diseases, particularly pancreas cancer. (Nucl. Sci. Abstracts of Japan, 3: No. 2 (Apr. 1964))

23393 THE RADIOISOTOPE RENOGRAM—ITS CLINICAL APPLICATION IN THE FIELD OF INTERNAL MEDICINE. Jugoro Takeuchi, Yoshihito Takazawa, Masamichi Saito, Kazuyuki Kobayashi, Yasuji Mizumura, Yasushi Nakamoto, and Syojiro Nakaya (Kanazawa Univ., Japan). Radioisotopes (Tokyo), 13: 159-67(Mar. 1964). (In Japanese)

A new method for evaluation of the renogram is described and its clinical application in the field of internal medicine is discussed. A new index to be applied to the renogram as a quantitative test of renal function is proposed and tentatively called the Renal Function Index (RFI). The index is based on measurements of the initial spike (a), the height of peak point (b), the time from point A to point B (d), and the height of the third segment at the time of d from B (f) and can be calculated by the formula: $RFI = (b/a - f/b) \times 1/d$. In 12 normal subjects, the mean of RFI was 0.36 ± 0.04 and the ratio of the right kidney to the left 0.98 ± 0.15. Values of RFI were also found to be satisfactorily reproducible in both normal and renal diseases. Features of the index are: it can evaluate the three segments of the renogram as a whole; the calculation is simple; and the time needed for renography is relatively brief. For evaluating renal function in bilateral renal diseases, the correlation coefficient between RFI and renal plasma flow was calculated in 12 cases of chronic glomerulonephritis and 26 cases of essential hypertension, a value of +0.81 being obtained. Because of this highly correlated relation, RPF could be roughly estimated from values of RFI. The clinical value of renography as a screening test for detecting unilateral renal diseases was compared with those of intravenous pyelography and aortography. Renography was found to be useful for detecting unilateral renal diseases equally to intravenous pyelography and aortography. Renograms in hydration and dehydration states were compared in 56 cases of normal, essential hypertension, chronic glomerulonephritis, and unilateral diseases. Values of RFI were usually smaller in the dehydrated state than in the hydrated state, with no specificity to any particular diseases being observed. Influences of Rontyl (hydroflumethiazide) on the renogram were investigated in 28 subjects. RFI values of five cases out of 28 were significantly improved by intravenous administration of 25 mg of Rontyl. Four of the above five cases were found to be essential hypertension with lower values of RPF. Such an improvement was seldom encountered in chronic glomerulonephritis with the same level of RPF. (P.C.H.)

23394 AN IMPROVED WHOLE-BODY COUNTING GEOMETRY WITH A SINGLE NaI(Tl) DETECTOR (8 × 4 INCHES). A. S. Chhabra (Atomic Energy Establishment, Trombay, India). Radiology, 82: 816-26(May 1964).

A new whole-body counting geometry based on the use of a 50-cm-arc chair and a single NaI(Tl) crystal detector, of 8-in. diameter and 4-in. thickness has been developed. Preliminary data for the response to a point source at various positions around the crystal were used to achieve this appropriate geometry. A comparison of the counts obtained with the 50-cm arc was made with those of the Argonne tilting chair (42 cm) and 1-meter-arc geometries, with the use of a solid Masonite phantom with point sources, on normal subjects who were given Co^{58} and I^{131}. The counting responses with time and position were studied for the three geometries. For measurement of radionuclides deposited in specific organs, rather than the total body, the 50-cm-arc geometry gives higher sensitivity and better response than the tilting chair used in many counting facilities. For radionuclides having total body distribution, the response is about the same for the two geometries. (auth)

23395 A TECHNIC OF EXPERIMENTAL DOSIMETRY FOR INTRACAVITARY RADIUM APPLICATORS. Frank W. Lane, Jr. (Mary Hitchcock Memorial Hospital, Hanover, N. H.), Noye M. Johnson, and F. John Bargoot. Radiology, 82: 827-30(May 1964).

A technique was described of mapping the radiation field around an intracavitary radium applicator, utilizing the Potsaid-Irie radiation detector wax calibrated by LiF dosimeters. This would appear to be useful in checking the dose distributions for individual radium applicators. (auth)

23396 INTERSTITIAL TIME-DOSE CORRECTIONS. Gordon C. Johnson (Univ. of Miami, Fla.). Radiology, 82: 831-2(May 1964).

Isoeffect curves for short durations are presented in a form for clinical use. These curves are based on the data of Paterson that were obtained from observations of Manchester System radium needle implants. (tr-auth)

CHEMISTRY

General

23397 (AEC-tr-6316(p.274-82)) MOISTURE DETERMINATION OF CELLULOSE FIBER USING O^{18}. Kozo Hirota, Hideo Terasaki, and Motoyoshi Hatada. (Translation)

Experiments were made on viscose rayon in an attempt to use the exchange reaction between H_2O and CO_2 to measure the moisture content. The reaction was promoted by Pt catalyst or beta radiation. The results using Pt catalyst gave a moisture content of 0.028%, indicating that 5 hr drying at 90°C does not remove moisture completely. Preliminary results using irradiation indicate that equilibrium was not attained in sealed ampoules of H_2O-CO_2 mixtures. (D.L.C.)

23398 (AEC-tr-6316(p.395-400)) EFFECT OF HEAT TREATING AND IRRADIATING POLYVINYL CHLORIDE. Isamu Nitta, Shunichi Onishi, and Yoshiharu Nakajima. (Translation)

An investigation was conducted on the use of heat treatments and gamma irradiations to increase the number of unpaired electrons in polyvinyl chloride. Heat treatment increased the number of unpaired electrons to a remarkable degree, but gamma doses up to 6×10^7 r had no effect. Gases produced during heat treatment suppress the unpaired electrons somewhat. (D.L.C.)

23399 (AEC-tr-6316(p.551-7)) ESR OF α,α'-DIPHENYL-β-PICRYL HYDRAZYL. Hisashi Ueda, Zenichiro Kuri, and Shoji Shida. (Translation)

Some new ESR data are presented on DPPH in degassed liquids. The effects of air, hydroperoxide, and yellow lophine oxidation product on the spectra of DPPH were studied. The results show that dissolved oxygen contributes to the stability of the radical. The experimental spin density for the ϕ-N-ϕ radical is compared with that calculated by Gutowsky. (D.L.C.)

23400 PROCESS OF COATING A SURFACE WITH AN IRRADIATED POLYMERIZABLE MATERIAL. Thomas Picton Hughes and William Henry Thomas Davison (to T.I. (Group Services) Ltd.). U. S. Patent 3,132,966. May 12, 1964. Priority date Mar. 24, 1960, Great Britain.

The process is based on the action of an intense electron beam on a polyester-based paint just before it is applied to an article or surface. The exposure to the electron beam takes place while the paint is falling under gravity or suspended in air in the form of a spray issued from a paint-spraying gun. Several ways of adjusting the speed of the curing reaction are described. (D.L.C.)

23401 (AEC-tr-6316(p.660-8)) ESR OF CARBON BLACK. Koji Otsubo and Kunio Araki. (Translation)

The free radicals present in Channel Black, Furnace Black, and Thermal Black were studied by ESR methods. Differences in the wave form and width were observed between the carbon types. Heat treatment in vacuum produced spectral changes for Channel Black. Gamma irradiation did not produce any increase in the radical population. (D.L.C.)

Analytical Procedures

Refer also to abstract 23886.

23402 (AERE-R-4466) RADIOACTIVITIES IN HUMAN AND ANIMAL BONES. M. J. Owers and A. Parker (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). Feb. 1964. 19p.

An analytical method for the determination of ^{90}Sr, ^{137}Cs, ^{144}Ce, and some Ra isotopes in bone is described. Results obtained for these nuclides in samples of human and animal bones are presented and discussed. (auth)

23403 (AERE-R-4608) THE DETERMINATION OF OXYGEN/METAL RATIOS FOR URANIUM, PLUTONIUM AND (U,Pu) OXIDES. T. L. Marken, A. J. Walter, and R. J. Bones (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Apr. 1964. 19p.

Non-stoichiometric uranium oxides can be analyzed by reduction to $UO_{2.00}$ with CO and measurement of the CO_2 produced. Thermodynamic data supported the validity of this method and also established the conditions for extending similar methods to the analysis of substoichiometric plutonium oxides and to mixed uranium–plutonium oxides. The theoretical bases of the method and recent practical developments are discussed. The accuracy of analyses obtainable by gas handling methods is illustrated by typical results, and possible future modifications are outlined. Oxygen/metal ratios can be determined to ±0.001 in the case of hyperstoichiometric MO_{2+x} oxides, and to ±0.002 in the case of hypostoichiometric MO_{2-x} oxides. (auth)

23404 (AI-8700(Vol.V)) ESADA FUEL FABRICATION DEVELOPMENT PROGRAM. TERMINAL REPORT. VOLUME V. PROCESS ANALYSIS—CHEMICAL, METALLOGRAPHIC, AND STATISTICAL. PART I. CHEMICAL AND METALLOGRAPHIC ANALYSES. C. D. Bingham, R. A. Harlow, A. Zonder. PART II. STATISTICAL ANALYSES. R. H. Anderson, L. D. Hicks, and D. N. Glass (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 30, 1963. 54p.

The procedures, techniques, and equipment utilized for the metallographic and chemical analysis of uranium carbide are described. The purpose of the analyses was to verify the control of the manufacturing processes, and to attest to the conformance of the product to specification. (auth)

23405 (CEA-R-2415) NOUVELLE METHODE DE DOSAGE DE L'URANIUM DANS LES MILIEUX BIOLOGIQUES. (A New Method for Measuring Uranium in Biological Media). Philippe Henry and Christian Kobisch (France. Commissariat a l'Energie Atomique. Centre de Production de Plutonium de Marcoule, Chusclan). Apr. 1964. 11p.

A new method is described for measuring U in biological media based on measurement of alpha activity. After treatment of the sample with a mineral acid, the U is reduced to the valency four by trivalent Ti and is precipitated as phosphate in acid solution. The U is then separated from the Ti by precipitation as UF_4 with La as carrier. A slight modification, unnecessary in the case of routine analyses, makes it possible to eliminate other possible alpha emitters. (C.H.)

23406 (CONF-512-4) THE MASS ANALYSIS OF SMALL SAMPLES UTILIZING A SPUTTERING ION SOURCE. James A. McHugh and James C. Sheffield (Knolls Atomic Power Lab., Schenectady, N. Y.). Apr. 28, 1964. Contract W-31-109-eng-52. 12p.

From American Society for Testing and Materials 67th Annual Meeting, Chicago, June 1964.

An ion source that generates positive ions by sputtering was shown to be of value for the isotope abundance analysis of small solid samples. The small sample efficiency of this source makes possible the mass analysis of a number of elements, which perform poorly in thermal sources The analysis of less than 10^{-8} grams of Be, B, Ni, Cu, Ag, and Sn was accomplished. (auth)

23407 (DP-880) A GAS CHROMATOGRAPH FOR DETERMINING O_2, N_2, NO, N_2O, SO_2, AND H_2S IN STEAM. David L. West (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Mar. 1964. Contract AT(07-2)-1. 15p.

A gas chromatograph was designed, assembled from existing components, and tested for the determination of O_2, N_2, NO, N_2O, SO_2, and H_2S in superheated steam. In a four-column arrangement, water was stripped from the sample by a polar partition column at 160°C, and then the remaining components were resolved by the other three columns at room temperature. A sample can be analyzed automatically in 20 minutes. The minimum detectable concentration was 0.1 vol % or less for all gases except H_2S, for which the minimum was 0.3 vol %. (auth)

23408 (NVO-162-8) STRONTIUM-90—METHOD DEVELOPMENT AND DETERMINATION. Peter J. Peterson (Reynolds Electrical and Engineering Co., Inc., Las Vegas, Nev.). Apr. 1964. Contract AT(29-2)-162. 20p.

The Kawabata-Held method of ^{90}Sr determination was adopted after evaluation of other methods. The procedure combines the fuming nitric acid precipitation with ion exchange to provide an analytical scheme, which is quantitative for ^{90}Sr, has good precision, is easily adapted to the analysis of a wide variety of sample types and sizes, results in a pure ^{90}Y fraction for counting, and eliminates self-absorption considerations. Other current methods are summarized. Sample preparation procedures are described for various materials. Calculation methods are given. (M.C.G.)

23409 (RT/CHI(63)-31) RAPID SEPARATION OF Np^{239} FROM Pa^{233}. C. Cesarano and G. Pugnetti (Italy. Comitato Nazionale per l'Energia Nucleare. Centro di Studi Nucleari, Casaccia). Oct. 1963. 13p.

A method is described, which allows a rapid separation of ^{239}Np from ^{233}Pa. The method is suited for determination of a small amount of uranium by activation analysis in a specimen containing a small amount of thorium. The two isotopes are adsorbed on an anion exchange column from 9$\underline{N}$ HCl. ^{239}Np is eluted first with 5$\underline{N}$ HCl. The distribution coefficients are discussed. (auth)

23410 (TID-7015(Suppl.6)) OAK RIDGE NATIONAL LABORATORY MASTER ANALYTICAL MANUAL. (Oak Ridge National Lab., Tenn.). June 1964. Contract W-74-5-eng-26. 496p.

Thirteen methods to be added to the Oak Ridge National Laboratory Master Analytical Manual are presented. These include 6 ionic methods, 5 radiochemical methods, 1 nuclear analysis method, and 1 general process method. Also included are 50 revised issues. (M.C.G.)

23411 (TID-20614) APDA SODIUM TECHNOLOGY LOOP. Summary Report, April 1964. (Atomic Power Development Associates, Inc., Detroit). Contract AT(11-1)-865. 5p.

A program is being carried out to evaluate in-line meters designed to detect impurities in operating sodium loops. Capabilities for analysis of liquid sodium for carbon, oxygen, and hydrogen are described. Total carbon is determined by high-temperature combustion, carbonate carbon by alcohol dissolution and acid decomposition, oxygen by mercury amalgamation of sodium oxide, and hydrogen by thermal decomposition of hydrogen compounds and absorption of evolved hydrogen on an active metal. (M.C.G.)

23412 (UCRL-7756) TITRATION OF BORIC ACID IN AQUEOUS SOLUTION—A STUDY OF SOME TITRATION VARIABLES. David M. Colman and Lester P. Rigdon (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 12, 1964. Contract W-7405-eng-48. 19p.

The effects of varying the mannitol concentration, type of ions, ionic concentration, and temperature on the titration of aqueous solutions of boric acid with NaOH were studied. The volume of titrant and the pH at the equivalent point were determined from potentiometric curves and by calculating the second derivative of the curve. Data are presented to show that the pH of the solution at the equivalent point may vary from 6.3 to 9.2. The use of potassium hydrogen phthalate rather than boric oxide to standardize the titrant is discussed. (auth)

23413 (UR-644) THE DETERMINATION OF TOTAL IODINE IN I-131 IODIDE PREPARATIONS OF HIGH SPECIFIC ACTIVITY. Ralph W. Helmkamp, Ma. de los Angeles Contreras, and William F. Bale (Rochester, N. Y. Univ. Atomic Energy Project). Mar. 26, 1964. Contract W-7401-eng-49. 32p.

A procedure is described for the determination of total iodine in ^{131}I-iodide preparations of high specific activity by analysis of samples containing less than 1 μg of iodine. The iodide in a sample of known radioactivity is oxidized to iodate by addition of Br_2 and sufficient H_2SO_4 to make the solution slightly acidic. The excess Br_2 is expelled by heating the solution in boiling water and simultaneously aerating it with a slow stream of nitrogen for 3 minutes. After the radioactivity of the solution is redetermined, 5.0 μg I as KI is added and the solution made approximately 0.5 N in H_2SO_4. The I_2 liberated is volatilized by heating and aerating the solution again for 3 minutes, and the amount vaporized is determined by measurement of the radioactivity of the residual solution. In control runs at a tracer level of ^{131}I-activity, with quantities of I^- varying from 0.10 to 0.90 μg, it was found that 92 to 94 per cent of the I_2 theoretically formed is volatilized under the conditions used. A corresponding correction is therefore applied to the results obtained by this procedure. It is shown that the ^{131}I-iodination efficiencies achieved on iodinating protein in the presence of ^{131}I-iodide samples of high specific activity by the iodine monochloride method can be predicted on the basis of the analyses of these preparations for total iodide. (auth)

23414 (Y-1464) SPECTROPHOTOMETRIC DETERMINATION OF LOW CONCENTRATIONS OF NICKEL IN THORIUM METAL USING DIMETHYLGLYOXIME. Wallace F. Carden and Virginia M. Giles (Union Carbide Corp. Nuclear Div. Y-12 Plant, Oak Ridge, Tenn.). Apr. 6, 1964. Contract W-7405-eng-26. 14p.

A spectrophotometric method for the analysis of low concentrations of nickel (approximately 50 to 500 ppm Ni) in thorium metal was developed. This method complexes thorium with ammonium citrate and uses dimethylglyoxime as the coloring agent. (auth)

23415 (JPRS-24552(p.60-1)) THE UTILIZATION OF α-METHOXY-BENZYL-ACETIC ACID AS PRECIPITANT FOR ZIRCONIUM. Shu-chuan Liang and Shun-yung Wang. Translated from K'o Hsueh T'ung Pao, No. 2, 157(1964).

Experimental results showed that α-methoxybenzyl acetic acid can separate white powdery precipitates from a zirconium solution containing several grams of ammonium chloride at a pH of 0.8 to 1.4. The gram molecular proportion of zirconium in the organic portion was in the ratio of 1 : 1. Quantitative precipitation required 16 times the theoretical precipitant (on a basis of 1 : 1). This method could be used to determine precipitants as low as 2.6 mg of zirconium. (M.C.G.)

23416 (JPRS-24593(p.10-12)) THE SEPARATION AND DETERMINATION OF ZIRCONIUM AND THORIUM. Chang-kuang. Translated from K'o Hsueh T'ung Pao, No. 2, 164(1964).

A method was previously reported for determination of thorium using iodo-phenyl-formic acid. It was found that in the presence of strong HCl and with heating, iodo-phenyl-formic acid and zirconium form a white cotton-like precipitate. When the HCl concentration was between 0.1 and 0.16N zirconium could be precipitated quantitatively. Thorium could be precipitated quantitatively in weak acid (pH >2.2). (M.C.G.)

23417 STUDIES ON THE RADIOCHEMICAL PURITY OF SOLUTIONS OF PHOSPHATES AND PYROPHOSPHATES OF SODIUM-^{32}P BY MEANS OF ELECTROPHORESIS AND CHROMATOGRAPHY. M. del Val Cob, I. Carnicero, N. Ortin, and J. M. Gamboa (Junta de Energia Nuclear, Madrid). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. B, 59: 755-64(Dec. 1963). (In Spanish)

Chromatographic and electrophoretic techniques were used for the systematic determination of the radiochemical purity of radioactive solutions for medical use. In the case of phosphate-^{32}P solutions the impurities that were searched were pyrophosphate-^{32}P and sulfate-^{35}S as well as traces of non radioactive elements like Fe, Ca, Al, and Si. Ionic exchange and filtration were used as purification methods. An attempt was made for the detection of the above mentioned trace elements by activation analysis and its behavior in radioactive phosphate solutions was studied by means of radioactive tracers. Under such conditions it was found that the phosphate ion and these elements form compounds that behave electroforetically as individual entities. Such entities are considered to be non neutral complexes that are stable only at certain values of pH. For pyrophosphate-^{32}P, the impurification by phosphate-^{32}P and sulfate-^{35}S was studied. (auth)

23418 THE DETERMINATION OF CALCIUM AND MAGNESIUM IN BIOLOGICAL MATERIAL BY RADIOACTIVATION ANALYSIS. H. J. M. Bowen, P. A. Cawse, and M. Daglish (Atomic Energy Research Establishment, Wantage, Berks, Eng.). Analyst, 89: 266-71(Apr. 1964).

Neutron activation analysis was used for determining Ca and Mg in biological material. The Ca was determined either as 8.8-min ^{49}Ca or as its daughter, 58-min ^{49}Sc, and the Mg as 9.5 min ^{27}Mg. The limits of sensitivity were about 3×10^{-6} g for Ca and 2×10^{-7} g for Mg. Manganese and P interfered, but there was no mutual interference between Ca and Mg. (auth)

23419 A LIQUID SCINTILLATION COUNTING METHOD FOR MEASURING TRITIATED WATER IN SOILS. Tsutomu Ojima, Hirokazu Toratani, and Hiroshi Fujimoto. Ann. Rept. Radiation Center Osaka Prefect., 4: 103-6(1963).

The optimum composition of scintillating solution for measuring simple tritiated water was ascertained, and the recovery test of tritiated water added to soils was carried out. The optimum scintillation mixture used for incorporating the tritiated water is composed of 7 g of 2,5-diphenyloxazole, 0.05 g of p-bis[2-(5-phenyloxazolyl)] benzene, and 120 g of naphthalene, all added to 1000 ml of p-dioxane. This solution offers the counting efficiency of tritium of 15 to 7% at the range of 0.5 to 3.5 ml of tritiated water added to 15 ml of scintillating solution. Recovery tests of the tritium activity added to soils were carried out in the manner of counting the water samples that were gained by distillation, extraction, or centrifugation of the treated soils, and the results were reasonable. (P.C.H.)

23420 DETERMINATION OF ZIRCONIUM BY MICROPERIODATE METHOD. A. A. Veridizade and A. A. Albendov. Azerb. Khim. Zh., No. 4, 149-56(1963). (In Russian)

Studies of zirconium with periodates showed a constant composition zirconyl dehydroparaperiodate precipitate $(ZrO)_3(HIO_6)_2$. The microperiodate method is capable of determining a minimum of 2.4×10^{-2} mg and maximum 0.517 mg Zr in 10 ml solution. Determination of more than 0.517 mg Zr involves repeated elution of 25 or more times. Determination of 0.2068 mg or less zirconium is possible in an oxygen-free medium with carbon dioxide passing over the solution or by adding sodium bicarbonate. (R.V.J.)

23421 CONTRIBUTION TO THE METHOD OF SEPARATING SOME ELEMENTS OF THE ALKALINE EARTH GROUP ON ION EXCHANGERS. E. Hantabal, M. Fojtik, V. Rusek, and T. Trnovec (Inst. for Hygiene of Work and for Occupational Diseases, Bratislava). Chem. Zvesti, 18: 203-8(1964).

A method suitable for the determination of radioisotopes of ^{90}Sr, ^{140}Ba, and ^{226}Ra in urine and river and drinking water is described. Sr and Ba salts are added as carriers, and the metals of the alkaline earth group are precipitated as carbonates. Ca is separated by the nitrate method. Sr, Ba, and Ra are separated on an ion exchanger by elution with a 4% solution of ammonium citrate at pH of 7.8-8.1. (OTS)

23422 ON THE NOMOGRAPHIC DETERMINATION OF INTERFERENCES AND LIMITS OF DETERMINATION OF ELEMENTS BY GAMMA SPECTROMETRY AFTER NEUTRON ACTIVATION. W. Haerdi (Universite, Geneva). Chimia (Aarau), 18: 138-9(Apr. 9, 1964). (In French)

Nomographic representations for determining the count rate (cps/g) from irradiation of an element and for determining and accounting for isotopic interferences in activation analysis are described. (D.C.W.)

23423 USE OF CATION-EXCHANGE RESIN FOR TOTAL ANION ANALYSIS OF AQUEOUS SOLUTIONS CONTAINING BERYLLIUM(II) ION. R. P. Bhatnagar, R. C. Arora, and B. G. Mahajan (Government Science Coll., Gwalior, India). J. Indian Chem. Soc., 41: 81-2(Jan. 1964).

The Be^{2+} ion was used to investigate the possibilities of total anion analysis in its presence by cation exchangers in H-form. Samples analyzed in this way contained mole-equivalent ratios of anion to Be. The time for analysis per sample was about 15 to 20 min for all steps. A similar method was also used for the total cation concentration of beryllium sulfate and beryllium chloride solutions, using Amberlite IR-120 (H). The exchange of Be ion on H-form of the resis afforded equivalent quantities of acids in effluents, which were titrated with standard alkali solutions to phenolphthalein end point. Titra values corresponded to the total anion concentration in the solutions from which the cation concentration was calculated. The results indicate that anion analysis of solutions containing Be^{2+} can be carried out with great accuracy and rapidity. (P.C.H.)

23424 DETECTION OF SUB-MICRO QUANTITIES OF THORIUM BY SOLOCHROME AZURINE B.S. Sarvagya S. Katiyar and S. N. Tandon (Indian Inst. of Tech., Kanpur, India). Mikrochim. Ichnoanal. Acta, No. 1, 55-9(1964).

Solochrome Azurine B. S. was introduced as a new color reagent for the detection of thorium in sub-micro quantities. Thorium gives a bluish color with the dye at pH 4. The limit of identification is 0.22 μg of thorium. (auth)

23425 RE-ACTIVATION ANALYSIS OF MERCURY. Yuichiro Kamemoto and Shigeru Yamagishi (Japan Atomic Energy Research Inst., Tokyo). Nature, 202: 487-8(May 2, 1964).

A re-activation analysis in which the chemical yield of mercury is easily corrected by re-activation of the counted sample is described. The method consists of neutron irradiation, addition of carrier, solvent extraction, counting, a second neutron irradiation, cooling, and counting. (C.E.S.)

23426 DETERMINATION OF THE ^{18}O CONCENTRATION IN WATER BY IRRADIATION WITH NEUTRONS. D. C. Aumann and H. J. Born (Technische Hochschule, Munich). Naturwissenschaften, 51: 159(1964). (In German)

Back-scattered protons from (n,p) reactions of fast neutrons in water cause the reaction $^{18}O(p,n)^{18}F$. The ^{18}F activity originating is a measure of the ^{18}O content of the water. By measurement of this activity and comparison with a standard sample the ^{18}O content can be determined. Examples using this method are described. (M.C.G.)

23427 ACTIVATION ANALYSIS DETERMINATION OF LITHIUM WITH THE HELP OF THE REACTION CHAIN $^{6}Li(n,d)^{3}H$ AND $^{16}O(t,n)^{18}F$. H. J. Born and D. C. Aumann (Technische Hochschule, Munich). Naturwissenschaften, 51: 159-60(1964). (In German)

When ^{6}Li is irradiated with neutrons, tritons are formed according to the reaction $^{6}Li(n,\alpha)^{3}H$. These tritons react with ^{16}O to form ^{18}F ($\sigma = 500$ mb). The activity of ^{18}F can be measured with a scintillation detector and the amount of lithium present can be calculated. Procedures for carrying out this method of analysis are given. (M.C.G.)

23428 SECOND-ORDER INTERFERENCE IN ACTIVATION ANALYSIS. Enzo Ricci and Frank F. Dyer (Oak Ridge National Lab., Tenn.). Nucleonics, 22: No. 6, 45-50 (June 1964).

In high-sensitivity activation analysis, second-order reactions may contribute inaccuracies to trace-element measurements. The interferences calculated in this article help correct these errors. (auth)

23429 SPECTROPHOTOMETRIC STUDIES OF URANIUM(VI) COMPLEX WITH 3-PHENYLDAPHNETIN. B. D. Jain and Raj Kumar (Univ. of Delhi). Proc. Indian Acad. Sci., Sect. A, 59: 185-9(Mar. 1964).

The spectrophotometric studies of the uranium complex with 3-phenyldaphnetin and the possible use of this reagent for the spectrophotometric estimation of uranium are discussed. An ethanolic solution of the reagent when added to a uranium (VI) salt solution produces an orange-yellow-colored complex soluble in aqueous ethanol. The molar composition of the complex was found to be 1 : 1, and it obeys Lambert-Beer's law at 430 mμ upto 9.00 ppm of uranium. (auth)

23430 QUANTITATIVE ANALYSIS UTILIZING ISOTOPIC EXCHANGE REACTION. DETERMINATION OF TRACE AMOUNTS OF SILVER. Shizo Hirano, Atsushi Mizuike, and Eiichiro Nakai (Tokyo Univ.). Radioisotopes (Tokyo), 13: 118-21(Mar. 1964). (In Japanese)

The isotopic exchange reaction between Ag in aqueous ammoniacal solution and ^{110m}Ag-labeled Ag diethyldithiocarbamate in carbon tetrachloride was applied to the determination of trace amounts of Ag in aqueous solution. The decrease in radioactivity of the organic phase due to the isotopic exchange reaction was measured for the determination. The error is within 5% over the range 1 to 20 μg of Ag, and the time required for a determination is about 15 min. The method was successfully applied to the analysis of high-purity Pb without any preliminary separation. (auth)

23431 THE RADIOCHEMICAL DETERMINATION OF ANTIMONY-125 IN SOILS. S. V. Iokhel'son and D. K. Popov. Radiokhimiya, 6: 117-19(1964). (In Russian)

^{125}Sb is an important constituent of an aged fission product mixture, and can constitute 7.5% of the total γ activity of a four year old mixture of fission products. In analyzing soil for fallout ^{125}Sb, the soil sample is dried at 200°C and ground. Holdback carriers in solution are added to 20 grams of soil sample: 76 mg of Y_2O_3, 46 mg $SrSO_4$, 95 mg $Cs_3Bi_2I_9$, 51 mg CeO_2, 47 mg La_2O_3, and 49 mg Sb_2S_3. Most of the silica in the sample is eliminated by treating with a mixture of HF and HNO_3. Hydroxyamine hydrochloride is added to convert Sb(V) to Sb(III). A hydroxide precipitation is performed by neutralizing an acid solution with CO_2-free ammonia. The hydroxides are dissolved in 2$\underline{N}$ HCl, and antimony is precipitated as Sb_2S_3, which is dissolved in a mixture of H_2SO_4 and HNO_3. The solution is evaporated to white fumes of H_2SO_4 to remove ^{106}Ru contaminant. Sb_2S_3 is precipitated from acid solution 3 or 4 times. The yield of Sb is 60 to 80%. An analysis of the γ spectrum on a 100-channel scintillation counter showed the presence of gamma peaks at 175, 440, and 595 kev. Beta absorption analysis in aluminum gave maximum beta energies of 0.6 Mev (25 mg/cm^2) and of 0.3 Mev (7 mg/cm^2). These data indicated that the ^{125}Sb activity was radiochemically pure. (TTT)

23432 A γ-SPECTROMETRIC METHOD OF ANALYSIS OF THE RADIOACTIVE IODINE-131 AND IODINE-132 ISOTOPES. S. V. Belov and V. S. Anikin. Radiokhimiya, 6: 132-5(1964). (In Russian)

In view of the differences of their β spectra, the various radioactive iodine fission products have differing biological effects and their concentrations must be determined individually, in addition to the measurement of the total activity. ^{131}I and ^{132}I, with $T_{1/2}$ = 8.14 days and 2.2 hours, respectively, which are Te daughters, are the most important from the viewpoint of biological activity. The concentration of these isotopes is usually determined on the basis of their β activity with 4π counters, followed by measurement of the activity decrease as a function of time. A method developed in which the γ activity of the isotopes is determined using a NaI(Tl) γ-spectrometer and a photomultiplier. Irradiated U exhibited 4 photoelectron maxima: 0.364 Mev (^{131}I); 0.51, 0.665, and 0.96 Mev (^{132}I). After one day, the curve corresponded to that of pure ^{131}I. The ^{132}I content may be obtained from the 0.96-Mev maximum, as it involves only γ radiation; the activity of ^{131}I was determined on the basis of the 0.364-Mev maximum. The divergence between the 2 methods did not exceed ±5%. The γ-spectrometric method makes it possible to obtain definite values by making only a single measurement immediately after purifying the material while the old method requires repeated measurements during 1½ to 2 days. (TTT)

23433 A QUADRUPOLE HIGH-FREQUENCY MASS SPECTROMETER FOR VACUUM TECHNOLOGY APPLICATIONS. C. Brunnee, L. Delgmann, and K. Kronenberger (Atlas-Mess-und Analysentechnik GmbH, Bremen, Ger.). Vakuum-Tech., 13: 35-42(Mar. 1964). (In German)

Construction and performance data of a quadrupole mass spectrometer for the analyses of residual gases in high- and ultra-high vacuum systems are given. The quadrupole tube with its length of 20 cm is of all metal construction and bakeable up to 450°C. As the mass separation is performed via a high frequency field no deflecting magnet is used. The ion source is constructed as a nude system and the normal ion collector can be exchanged against a secondary electron multiplier. The mass range is from mass number 1 to 120 with a resolution M/ΔM of approximately

100. For 100% transmission the sensitivity amounts to approximately $2 \cdot 10^{-4}$ A/Torr; the smallest detectable partial pressure is in the region of 10^{-13} Torr. (auth)

23434 QUANTITATIVE β AND γ SPECTROMETRIC ANALYSIS BY THE METHOD OF LEAST SQUARES. J. Legrand (CEN, Saclay, France). p.429-35 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

Quantitative γ-spectrometric analysis, currently used for simple γ-spectra, cannot be practically applied for mixtures of several radionuclides. The method described consists of producing, under identical conditions, the spectrum of the mixture and those of each of the radionuclides present, using a scintillation counter (NaI, Tl) and a multichannel analyzer. The spectra obtained in the form of punched tape are processed on a computer (Pb 250) by the method of least squares to find the activity of each constituent of the mixtures, those of the standard sources being known. An identical technique is described for the analysis of β emitters, the NaI(Tl) scintillator being replaced by a plastic scintillator or a pressurized proportional counter. The results obtained and the limitations of the method are given and discussed. (auth)

Inorganic and Physical Chemistry

23435 (BM-RI-6446) THERMODYNAMIC DATA FOR COLUMBIUM (NIOBIUM) CARBIDE. Louis B. Pankratz, W. W. Weller, and K. K. Kelley (Bureau of Mines. Berkeley Thermodynamics Lab., Berkeley, Calif.). Sept. 1963. 12p.

The heat capacity of niobium carbide (NbC) was measured over the temperature range from 51 to 298°K, and the entropy at 298.15°K was evaluated. Also, the heat content above 298.15°K of niobium carbide was measured to 1,800°K. The results were combined with the known heat of formation at 298.15°K to obtain values of the heat and free energy of formation over the temperature range from 298.15 to 2,000°K. (auth)

23436 (CEA-R-2414) PRECIPITATION D'OXYDE D'URANIUM PAR REDUCTION EN MILIEU ALCALIN. (Precipitation of Uranium Oxide by Reduction in Alkaline Solution). Paul Pottier and Jacques Claus (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Fontenay-aux-Roses). Apr. 1964. 46p.

The reaction mechanism for the reduction that makes it possible to precipitate a hydrated uranium oxide from alkaline uranyl carbonate solution was studied. The effects of different variables on numerous cycles were determined. Optical, x-ray, and thermogravimetric examinations made it possible to predict the properties of this oxide. Calculations for the continuous operation of single cells and cells in series are presented. These calculations give the data required for the construction of 2 cells having capacities of 0.3 and 10 liters. Results obtained from the continuous operation of this latter cell were used to determine the applicability of this method to the hydrometallurgy of uranium. (auth)

23437 (CONF-322-12) SESSILE DROPS OF MOLTEN HALIDES ON GRAPHITE AND METALS. P. J. Kreyger and S. S. Kirslis (Oak Ridge National Lab., Tenn.). [1963]. Contract [W-7405-eng-26]. 26p.

From the American Chemical Society Production Technology of Np 237 and Pu 238, Denver, Jan. 1964.

The wetting behavior of molten fluoride and chloride salts on graphite, nickel, copper, gold, and platinum was studied by observations of sessile drops which involved sequential photographs and measurements of changes in contact angle. A vacuum-tight apparatus was assembled and equipped to operate with a static or flowing atmosphere of various gases. Molten KCl and NaCl–KCl mixture wet the graphite and the metals in the sense that the contact angle, Θ, was smaller than 90°. Molten fluorides with a high surface tension, e.g., Li_2BeF_4 and LiF–NaF, did not wet the graphite or metals, when the latter were free of surface oxides. Wetting of graphite by beryllium containing molten fluorides occurred when small amounts of water vapor (10 ppm) were present in the gas phase, resulting in the permeation by salt of the porous graphite. The decrease of the contact angle of the molten fluorides on graphite in the presence of water is explained by the formation of insoluble oxides from the salt at the three-phase contact line. As the salt wets the oxide, the liquid-solid contact line crawls forward, decreasing the contact angle. Wetting of the metals by molten fluorides occurred only when a layer of oxide was present on the metal surface. Reduction of the metal oxide by H_2 treatment of Ni and Cu, and by heating in the case of Au and Pt, led to an increase of the contact angle of the molten fluoride salts. (auth)

23438 (CONF-405-35) SPECTRAL EVIDENCE ON RARE-EARTH COVALENT BINDING. Leonard I. Katzin and M. Louise Barnett (Argonne National Lab., Ill.). [1963]. Contract W-31-109-eng-38. 35p.

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

Data are presented on absorption spectra changes for $^{3+}$Pr, $^{3+}$Eu, and $^{3+}$Er systems for which covalency was adduced on chemical grounds. The spectra are shown in graphs. There was not only a general change between the dilute aqueous spectrum and the spectrum in TBP, but each of the salts had a distinctive variation on the over-all change, indicating the role of the difference in specific bonding relations of the rare-earth central atom and the different anions. The specific nitrate absorption, below 3500 Å, showed a shift between the aqueous solution where it is ionized free, and the TBP solution where it is coordinated to rare earth ion. Halide absorption bands were observed that seemed to have the character of charge transfer bands. (M.C.G.)

23439 (CONF-405-36) VAPOR PRESSURES OF SAMARIUM AND GADOLINIUM. A. S. Yamamoto, C. E. Lundin, and J. F. Nachman (Denver. Univ.). [1963]. Contract AT(11-1)-742. 14p.

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

The vapor pressures of solid samarium and liquid gadolinium were determined in the temperature range of 1033 to 1302 and 1623 to 1784°K, respectively. Employed in this investigation was the Knudsen effusion method in which the weight-loss data of the effusion cells were used to calculate the vapor pressures. The data are represented as follows: for α-Sm (1033 to 1173°K), $\log_{10} P_{(mm\ Hg)} = -(11{,}900 \pm 300/T) + 9.71 \pm 0.24$; for β-Sm (1202 to 1302°K), $\log_{10} P_{(mm\ Hg)} = -(11{,}400 \pm 200/T) + 9.30 \pm 0.21$; and for liquid Gd (1623 to 1784°K), $\log_{10} P_{(mm\ Hg)} = -(14{,}740 \pm 424/T) + 8.51 \pm 0.25$. The heats of sublimation for samarium were obtained from the slopes of the above equations. For alpha-samarium the heat of sublimation is 54.45 ± 1.37 kcal/mole and for beta-samarium, 52.17 ± 0.92 kcal/mole. The average ΔH^0_{298} value values for alpha- and beta-samarium, computed using the third law method, are 48.92 ± 0.09 and 48.10 ± 0.11 kcal/

mole, respectively. The heat of transition for the metal is thus 820 cal/mole. The heat of vaporization for liquid gadolinium obtained similarly is 67.45 ± 1.9 kcal/mole. (auth)

23440 (CONF-405-38) DECOMPOSITION PRESSURE OF HOLMIUM CARBIDES. G. F. Wakefield, A. H. Daane, and F. H. Spedding (Ames Lab., Ames, Iowa). [1961]. Contract W-7405-eng-42. 19p.

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

The decomposition pressures of some of the carbides of holmium were determined with a Knudsen effusion apparatus. The dicarbide was found to decompose to the metal vapor and graphite, with the holmium pressure described by log P mm = (−19.481/T °K) + 6.723. The values $\Delta F^0_{f298} = -19.6$ kcal, $\Delta H^0_{f298} = -19.8$ kcal, and $\Delta S^0_{f298} =$ 7.6 eu were obtained. The sesquicarbide was found to lose holmium to form the dicarbide with the holmium pressure following the equation log P mm = (−22.355/T °K) + 10.22 and yielding $\Delta F^0_{f298} = 11.1$ kcal and $\Delta S^0_{f298} = 5.1$ eu. (auth)

23441 (CONF-405-40) COMPLEX COMPOUNDS IN THE SODIUM FLUORIDE–RARE-EARTH TRIFLUORIDE SYSTEMS. R. E. Thoma (Oak Ridge National Lab., Tenn.). [1963]. Contract W-7405-eng-26. 12p.

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

It was proposed that binary systems of sodium fluoride and rare earth trifluorides might show phase behavior analogous to that in the system $NaF-YF_3$. Experiments corroborated this view. Phase diagrams were constructed on the basis of thermal transition and phase identification data obtained from both slowly cooled mixtures and quenched specimens as well as from inferences based on observed regularities in the phase transition temperatures. Two equilibrium compounds were found to occur: $NaF-REF_3$ and $SNAF-9REF_3$, where RE is rare earth. There was a marked tendency for the number of intermediate crystal phases produced by the interactions of a given component pair to increase with increasing cation radius ratio. (M.C.G.)

23442 (CONF-405-41) SPECIFIC HEAT OF THULIUM METAL BETWEEN 0.38 AND 3.9°K. O. V. Lounasmaa (Argonne National Lab., Ill.). [1964]. Contract W-31-109-eng-38. 20p.

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

The specific heat C_p of thulium metal was measured in a ^{3}He cryostat. Between 0.38 and 3.9°K, $C_p = 2.839T^3 + 17.94T + 23.43T^{-2} - 1.79T^{-3} - 0.066T^{-4}$ (in mJ/mole · °K). The last three terms represent the nuclear specific heat C_N. On the basis of earlier estimates, $C_L = 0.243T^3$ and $C_E = 10.5T$ were used for the lattice and electronic specific heats, respectively. According to the simple spin wave theory, the magnetic specific heat C_M is proportional to T^3 for a ferrimagnetic metal; experimentally, $C_M = 6.2T^{3/2}$ was found for thulium, which has a ferrimagnetic structure. Further, there seemed to be no evidence in C_M for an exponential factor, to be expected because of magnetic anisotropy. All conclusions on C_M were tentative, however. C_N did not fit to the simple picture as given by Bleaney either. Since $I = \frac{1}{2}$ for the only stable thulium isotope ^{169}Tm, quadrupole interactions are zero and there are only two nuclear energy levels, their separation being determined by the magnetic hyperfine constant a′. This would give a nuclear specific heat with even powers of T only, with a′ determining the values of the coefficients. The observed C_N cannot be fitted into an equation of this type, which indicates that other interactions, probably nuclear exchange interactions, are present. The experimental situation may be expressed by writing $a' = a_0 - b/T$, instead of treating a′ as a constant. The results are in good agreement with Mössbauer data by Kalvius et al. who found 22.9 for the coefficient of the T^{-2}-term. (auth)

23443 (HW-77710) CHANGES MADE IN WATER TREATMENT AT HANFORD. R. W. Pitman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 23, 1963. Contract AT(45-1)-1350. 9p.

Water treatment to provide large quantities of high-quality water for use as a coolant for the plutonium production reactors is described. Alum is added to raw water, settling is used to remove some of the solids and filtration the remainder. (M.C.G.)

23444 (JINR-P-1626) DINAMICHESKAYA POLYARIZATSIYA PROTONOV V KRISTALLE LANTANMAGNIEVOGO NITRATA S PRIMES'YU NEODIMA. (Dynamic Polarization of Protons in Single Crystals of Lanthanum Magnesium Double Nitrate Containing Various Concentrations of Nd). P. Draghchesku, M. Draghchesku, I. Lushchikov, B. S. Neganov, L. B. Parfenov, and Yu. V. Taran (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1964. 16p.

By the method of solid effect the dynamic enhancement factor of the proton polarization was found to be 500 for the protons in the water of hydration in single crystal of lanthanum magnesium double nitrate in which 1% of lanthanum was replaced by ^{142}Nd. Hydrogen polarization as high as 35% was repeatedly achieved at a temperature of 1.5°K and in a field of 10,000 gauss, using microwaves, of 37 Bc. The volume of the target was about 6 cm^3. The proton spin-lattice relaxation time was measured at various temperatures and concentrations of Nd. (auth)

23445 (K-1594) A VACUUM DISTILLATION SYSTEM FOR CONCENTRATING HEAT-LABILE SOLUTIONS. R. H. Stevens (Oak Ridge Gaseous Diffusion Plant, Tenn.). May 8, 1964. Contract W-7405-eng-26. 25p.

A vacuum distillation system for concentrating dilute aqueous solutions of thermally labile solutes at low temperature (15 to 25°C) was developed. Concentration ratios of 2 to over 100 can be obtained depending on solubility and original volume. Air is removed from the system for operation at the vapor pressure of the water condensate (5.3 mm Hg). Four boilers permit simultaneous concentration of four separate solutions at a water removal rate of approximately 770 ml/hr per boiler. Tests showed over 99% solute recovery for a 30:1 concentration of a 0.00002 N oxalic acid solution. The unit employs a mechanical refrigeration system to condense the distillate at 2°C. (auth)

23446 (LA-3006) USE OF THE KNUDSEN EFFUSION METHOD. A Literature Survey. John W. Ward (Los Alamos Scientific Lab., N. Mex.). Nov. 1963. Contract W-7405-eng-36. 123p.

References for the period 1940 to 1962 on the Knudsen effusion method for measuring vapor pressures were compiled. Two abstracting sources were surveyed: Chemical Abstracts and Nuclear Science Abstracts. In addition, the individual references given in the bibliographies of many papers were checked and a few unabstracted papers were found. Entries are arranged in yearly sections. Compound and formula, special subject, and author indexes are included. (M.C.G.)

23447 (ORNL-TM-831) LOW PRESSURE GRAPHITE OXIDATION AND MASS TRANSPORT TEST FACILITY. A. M. Smith, F. H. Neill, and R. E. MacPherson (Oak Ridge National Lab., Tenn.). May 1964. Contract W-7405-eng-26. 25p.

In a high temperature gas-cooled reactor system where graphite is used in the reactor core, carbon oxidation and mass transport problems are anticipated as a result of chemical reactions which will occur between the hot graphite and gaseous impurities present in the coolant stream. A closed loop test facility is described, which was constructed to supplement the available data on: helium purification, the problems of carbon mass transport, and the extent and rate of gas-carbon reactions that occur in a helium cooled system containing low partial pressures of impurities. (auth)

23448 (PAN-466/V) ADSORPTION OF H^+ AND OH^- IONS ON Ni AND Al SURFACES. Elwira Herczyńska and Krystyna Prószynska (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Oct. 1963. 42p.

The adsorption of H^+ and OH^- ions on Ni and Al surfaces is reported as a function of pH and electrolyte concentration of the solutions and of the nature of the anions and cations present in the solutions. (auth)

23449 (PAN-491/V) ELECTRICAL CONDUCTIVITY OF ALUMINIUM(III), GALLIUM(III) AND INDIUM(III) IODIDES IN ALKYL IODIDES. Aleksander Halpern and Andrzej Polaczek (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Dec. 1963. 9p.

The electrical conductivity of the AlI_3-CH_3I, GaI_3-CH_3I, InI_3-CH_3I, $AlI_3-C_2H_5I$, $GaI_3-C_2H_5I$, $InI_3-C_2H_5I$, $AlI_3-C_3H_7I$, $InI_3-C_3H_7I$, and $GaI_3-C_3H_7I$ solutions were measured. All these systems are weak electrolytes. The conductance increased with time, rapidly during the first 20 to 40 minutes, then slowly over a long period of time. (auth)

23450 (TID-20252) THERMAL EXPANSION OF ISOTOPICALLY-ENRICHED LITHIUM, 4.2°K TO 300°K. Donald D. Snyder, W. Bruce Zimmerman, and Henry Kuhlman (Andrews Univ., Berrien Springs, Mich.). [1963]. Contract AT(11-1)-972. 24p.

Extending the work of Robertson and Montgomery, the coefficient of linear thermal expansion as a function of temperature was determined semiquantitatively for isotopically enriched lithium samples from room temperature to liquid-helium temperature. ^6Li appeared to have a slightly larger coefficient than ^7Li. The shape of the curve of $\Delta L/L\Delta T$ vs temperature showed a sensitivity to the low temperature phase transition in lithium, which begins at approximately 80°K. (auth)

23451 (UCRL-7667) A COMPUTER CODE FOR THERMODYNAMIC ANALYSIS WITH APPLICATIONS TO TUNGSTEN AND RHENIUM VAPOR PLATING. G. E. Zima and R. J. Eckert (California. Univ., Livermore. Lawrence Radiation Lab.). Feb. 5, 1964. Contract W-7405-eng-48. 27p.

A computer program was devised for the free-energy analysis of a fairly general class of reactions. The basic thermodynamic analysis is extended with two additional programs designed for the rough screening of single and simultaneous reactions for the vapor plating process. The comparison index used is the total initial pressure needed to yield a given quantity of metal under displacement to equilibrium conditions. The expressions used in the calculations are given, and some applications to W and Re vapor plating reactions are summarized. (auth)

23452 (UCRL-10625) MECHANISM OF LIQUID-LIQUID SETTLING. Albert D. Epstein and C. R. Wilke (California. Univ., Berkeley. Lawrence Radiation Lab.). Jan. 14, 1963. Contract W-7405-eng-48. 49p.

The separation of two immiscible liquids in a gravity settler was studied in a program to learn more about the mechanism of the settling process. The liquids used were water and Aroclor 1248 (sp. gr. 1.36). A mixture of the two liquids was fed into one end of a long horizontal tank in which the two phases were separated by gravity and were drawn off at the top and bottom of the opposite end. The liquids were introduced through a pipe narrow enough to assure a high degree of turbulent mixing. The effectiveness of the settling process was determined by measuring the concentration of water in the Aroclor phase resulting from water dispersed during the initial mixing of the two phases and water showered down into the Aroclor during the coalescence of the droplets into their respective phases from an emulsion layer at the settler interface. The emulsion layer moved toward the settler outlet at two to three times the velocity of the Aroclor phase. For the system investigated, the depth and length of the emulsion layer were found to depend upon the Reynolds number in the mixing section. The settler flow patterns were also drawn for the cases in which the emulsion layer ended in the settler and those in which it extended the entire length of the section. (auth)

23453 (UCRL-11126) HEATS OF FORMATION OF Eu^{+3}(aq), Eu^{+2}(aq), AND $EuO_{1.02}$. John L. Burnett and B. B. Cunningham (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry). Feb. 1964. Contract W-7405-eng-48. 18p. (CONF-405-42)

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

A measurement was made of the heat of solution of europium metal in 0.1$\underline{N}$ HCl. EuO was prepared and its heat of solution was measured in 1.0$\underline{N}$ HCl. EuO was prepared by heating europium metal and europium sesquioxide together in a vacuum. For ^{3+}Eu, ΔH_f^0 was calculated to be -130.4 ± 1.0 kcal/mole; for ^{2+}Eu, -115.7 kcal/mole; and for EuO, -145.2 kcal/mole. The average heat of solution for europium metal in 0.1$\underline{N}$ HCl was found to be -164.57 ± 0.7 kcal/mole; for EuO in 1$\underline{N}$ HCl the value for heat of solution was found to be -87.8 ± 0.7 kcal/mole. (M.C.G.)

23454 (UNC-5077) THERMODYNAMICS OF THE URANIUM–NITROGEN SYSTEM. Annual Report. P. E. Lapat, J. J. Prusak, and R. B. Holden (United Nuclear Corp. Development Div., White Plains, N. Y.). Jan. 15, 1964. Contract AT(30-1)-3128. 32p.

A continuous vacuum balance technique was used to measure equilibrium decomposition pressures of U_2N_3 from 600 to 1100°C and N/U ratios from 1.7 down to the two-phase region UN + U_2N_3. Data were also obtained on UN at 1073°C and slightly hyperstoichiometric compositions. Some of the phase boundaries of the two nitrides were located. The partial molal heats and entropies of solution of N_2 in single-phase U_2N_3 were calculated as a function of composition. The heat of decomposition of U_2N_3 according to the reaction $x\ U_2N_3 = y\ UN + N_2$ was determined to be 57 kcal/mole of N_2, which is in excellent agreement with a previously reported value of 58 kcal/mole of N_2. The vacuum balance apparatus was modified to operate at temperatures above 1100°C. (auth)

23455 (WADD-TR-60-782(Pt.XXII)) VAPORIZATION OF COMPOUNDS AND ALLOYS AT HIGH TEMPERATURES. PART XXII. MASS SPECTROMETRIC DETERMINATION OF THE DISSOCIATION ENERGY OF THE MOLECULES MgO, CaO, SrO AND Sr_2O. John Drowart, G. Exsteen, and G. Verhaegen (Brussels. Université). Mar. 1964. Contract AF61(052)-225. 34p.

The dissociation energy of the molecules MgO, CaO, and SrO was determined. $D_0^0(MgO) = 85 \pm 5$; $D_0^0(CaO) = 92 \pm 5$;

$D_0^0(SrO) = 102 \pm 5$ kcal/mole. The ground state was considered to be $^1\Sigma$. This choice is discussed. A review and a discussion of the literature values for D_0^0(MgO, CaO, and SrO) are presented. The molecule Sr_2O was identified and its atomization energy determined: ΔH_0^0, at $(Sr_2O) = 193 \pm 6$ kcal/mole. (auth)

23456 (AI-Trans-46) SOME FUSIBLE ELECTROLYTES. Wilhelm Biltz and Wilhelm Klemm. Translated by Anthony Cornell (Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif.), from Z. Physik. Chem. Leipzig, 110: 318-42(1924). 28p.

An investigation was made of conducting chlorides as fusible electrolytes. The effects of the electrolytic apparatus on the results of measurements on molten halides were determined. Lithium, rubidium, cesium, cuprous, magnesium, zinc, and cadmium chlorides were studied. Conductivities and temperature coefficients were determined. (M.C.G.)

23457 (ANL-Trans-23) POLAROGRAPHY AND THERMODYNAMICS. II. SOLUBILITY AND THERMODYNAMICAL PROPERTIES OF BARIUM SULFATE AND BARIUM SELENATE. N. M. Selivanova and A. F. Kapustinskii. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Zh. Fiz. Khim., 27: 565-71 (1953). 11p.

Polarographic measurements lead to the following characteristics for the solubility of $BaSO_4$ and $BaSeO_4$: $BaSO_4$ solubility was 1.44×10^{-5} mole/l, the solubility product, Lp, equaled 2.04×10^{-10}, the activity product, La equaled 1.71×10^{-10}; $BaSeO_4$ solubility was 2.53×10^{-4} mole/l, Lp equaled 0.6×10^{-7}, and La equaled 0.5×10^{-7}. All data applied to a temperature of 25°C. The free energy of dissolution in water (at 25°C) was found to be 13,250 cal for $BaSO_4$ and 9,680 cal for $BaSeO_4$. Heat of dissolution of $BaSeO_4$ in water equaled 2,840 cal. The free energies of formation from the elements under standard conditions were correspondingly equal to 323,640 and 248,650 cal for $BaSO_4$ and $BaSeO_4$, respectively. The absolute entropy of $BaSeO_4$, S_{298}, equaled 25.8 entropy units. The entropy of the selenate-ion in water (obtained by two independent approaches) was 0.9 ± 0.3 entropy units, and in the crystal lattice it was equal to 14.4 entropy units. The heat of dilution of selenic acid in water was lower than that of sulfuric acid, which corresponds qualitatively to the hydration difference of both acids. It is believed that tetrahedral complex ions "replace" the grouping consisting of four water molecules in the tetrahedral structure of liquid water. (auth)

23458 (HW-tr-71) PRODUCTION OF UO_2 CRYSTALS BY ELECTROLYSIS OF FUSED CHLORIDES AT 450–550°C. G. Chauvin and H. Coriou (France. Commissariat a l'Energie Atomique, Paris). Translated by E. R. Appleby (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.), from report DM-1299, July 1963. 29p.

Results are reported on a method for the production of UO_2 crystals by electrolysis at relatively low temperature (450 to 550°C) in a molten chloride $LiCl-KCl-UO_2Cl_2$ bath. The results were superior to those from the usual electrolysis at high temperature (800 to 900°C) in the $NaCl-KCl-UO_2Cl_2$ bath. The crystals obtained have the following primary characteristics: O/U ratio, 2.00 to 2.01; density, 10.70 to 10.90; and size, 0.4 to 3mm (for 70% by weight of each deposit). Other characteristics (cathodic yield, carbon content, spectrographic analysis) appeared to be equally satisfactory. Certain points of this technique remain to be refined: for example, the conditions of washing and powdering. These crystals seemed to satisfy the conditions for fuel element fabrication by vibratory compaction methods. (auth)

23459 (JPRS-24593(p.37-41)) THE $2F_{5/2} - 2F_{7/2}$ ABSORPTION SPECTRUM OF Ce^{3+} IN SILICA AND BORAX GLASS. Hsi-huai Huang and Kao-ho Pi. Translated from K'o Hsueh T'ung Pao, No. 2, 178-9(1964).

The Ce^{3+} glass absorption spectrum in the infrared region was studied for several silica glasses. It was found that CeO_2 glass has an absorption peak at 3.5 to 5 μ. It was evident that Ce^{4+} under high-temperature melting will reduce to Ce^{3+} and be retained in a glass sample. (M.C.G.)

23460 (JPRS-24593(p.98-101)) PREPARATION OF SINGLE CRYSTALS OF CALCIUM FLUORIDE BY ZONAL FUSION. Feng-chu Tsui and Ning-san Chuan. Translated from K'o Hsueh T'ung Pao, No. 2, 150-1(1964).

A method of preparing high-quality single crystals of calcium fluoride is described. The crystals are formed at 1400°C and 2×10^{-4} mm in horizontal moving fusion zone equipment. For purification, wide fusion zones are used at the beginning. Then the fusion zone is gradually narrowed to 15 mm, and the shifting speed changed gradually from 156 to 57 mm/hr. In order to remove the internal strain from the crystals and stabilize the state of the ions of impurities, heat treatment at a temperature close to the melting point was necessary. (M.C.G.)

23461 (ORNL-tr-122) HYDROLYSIS OF URANIUM CARBIDES. J. Spitz and J. Besson. Translated for Oak Ridge National Lab., Tenn., from Bull. Soc. Chim. France, 1854(1963). 1p.

The hydrolysis of UC in neutral or acid media was found to lead to a complex mixture of hydrogen and saturated hydrocarbons with a little ethylene. The mechanism proposed for the reaction is the intermediate formation, simultaneously or successively of $\equiv CH$, $=CH_2$, and $-CH_3$ radicals. The hydrolysis of mixtures of monocarbides and dicarbides led to the formation of a complex mixture of hydrogen and hydrocarbons, gaseous and condensed, saturated and ethylenic. The reaction mechanism proposed is the primary formation of $=C=C=$ radicals directly from C_2 groups preexisting in the dicarbide. (M.C.G.)

23462 (SC-T-64-616) CONCERNING THE MIXED ADSORPTION OF RADON ON ACTIVATED CHARCOAL WITH VARIOUS CARRIER GASES. O. Guebeli and M. Stoeri. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.), from Helv. Chim. Acta, 37: 2224-30(1954). 9p.

Radon adsorption on wood charcoal was investigated with respect to its dependence on various carrier gases. The isosteric adsorption heats were ascertained mathematically from the experimentally determined adsorption data, as far as radon is concerned, which was accompanied by foreign gases such as air, nitrogen and carbon dioxide, including hydrogen. (auth)

23463 REVERSIBLE AND IRREVERSIBLE PROCESSES ON DROPPING MERCURY ELECTRODE. XVIII. STUDIES ON LANTHANIDES IN SUPPORT SOLUTIONS OF BROMOTETRAETHYL AMMONIUM. J. Sancho, J. Almagro, and V. Almagro (Universidad de Murcia, Spain). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. B, 59: 717-22(Dec. 1963). (In Spanish)

A study was made out on the M^{3+} ions of lanthanides in $BrN(C_2H_5)_4$ 0.1 $\underline{M}$ as supporting solution in presence of 25% and 50% ethyl alcohol and 0.01% of gelatin. Both classical and derivative polarography were used, the results being in accordance with those obtained with other supporting solutions, from the point of view of the reduction process in the mercury drop electrode and as regards of characteristics of analytical interest. (auth)

23464 SECOND ORDER CORRECTION OF THE QUADRUPOLE SPLITTING IN THE NUCLEAR MAGNETIC RESONANCE OF Na^{23} IN $NaClO_3$. Vaeineo Hovi, Mauri Luukkala, and Matti Punkkinen (Univ. of Turku, Finland). Ann. Acad. Sci. Fennicae, Ser. A VI, No. 140, 15p.(1964).

Quadrupole splitting in the nuclear magnetic resonance of ^{23}Na in $NaClO_3$ crystals and its second order correction were investigated both theoretically and experimentally. Theoretical results were calculated on the basis of Pound's paper. The distance between the resonance curves and the Larmor magnetic field was determined as a function of the angle between the magnetic field and a certain crystallographic direction of $NaClO_3$. It was found that, because of the second order correction, the observed satellite and central lines did not coincide in any direction of the magnetic field. Within the limits of the experimental error, the experimental results agreed with the calculated ones. For the quantity e^2qQ/h the value 787.4 ± 7 kHz was obtained from the measured data. (auth)

23465 THE PREPARATION OF MOLYBDENUM OXIDETETRACHLORIDE. R. Colton, I. B. Tomkins, and P. W. Wilson. Australian J. Chem., 17: 496-7(Apr. 1964).

A very rapid and convenient preparation of molybdenum oxidetetrachloride, $MoOCl_4$, by the action of thionyl chloride on molybdenum trioxide is reported. Thionyl chloride reacts rapidly with MoO_3 on refluxing to give an intensity colored red solution. Evaporation of this solution under vacuum gave a crystalline product that could be purified by sublimation at 50 to 60°C to give large green crystals. $MoOCl_4$ is thermally stable, melting at about 100°C to a dark brown liquid and giving a reddish brown vapor at about 120°C. (P.C.H.)

23466 ON THE KINETIC BEHAVIOR OF PROTONS AND DEUTERONS IN ICE CRYSTALS. M. Eigen, L. de Maeyer, and H.-Ch. Spatz (Max-Planck-Instutut für Physikalische Chemie, Göttingen, Ger.). Ber. Bunsenges. Physik. Chem., 68: 19-29(1964). (In German)

It is shown that the thermodynamic and kinetic parameters of the reaction $H^+ + OH^- \rightleftharpoons H_2O$ in ice can be obtained by a combination of three methods: (1) measurement of d-c conductivity, (2) measurement of the saturation current, (3) determination of the dissociation field effect. The absolute value and the temperature coefficient of the d-c conductivity were evaluated by measurements on ice crystals of very pure H_2O and D_2O. The dissociation field effect could be observed as a deviation from the saturation current at very high field intensities. Earlier measurements on H_2O-ice are largely confirmed. The measurements on D_2O-ice show very large isotope effects. These are discussed with reference to the zero-point energy differences of the valency vibrations of protons and deuterons. The difference in mobility of protons (~ 0.08 cm²/v sec) and deuterons (~ 0.01 cm²/v sec) can be explained by the special transport mechanism of the charge carriers in ice. It is shown that the proton jump in the hydrogen bridge is the rate-determining step of charge transport. (auth)

23467 THE ELECTRIC MOBILITY OF $^{42}K^+$ IONS IN AQUEOUS KNO_3 SOLUTIONS AT 25°C. L. Fischer and K. Hessler (Hahn-Meiter-Institut für Kernforschung, Berlin). Ber. Bunsenges. Physik. Chem., 68: 184-90 (1964). (In German)

Using $^{42}K^+$-cation as an example in aqueous solutions of KNO_3, the procedure of the direct measurement of the electric mobility of radioactive ions in solution is described. Conditions for the method and the accuracy are discussed and the results are quoted. The essential feature is the absence of an indicator solution that plays an important role in the moving boundary technique. The relative isotope effect of the electric mobility, referred to the isotope mixture of $^{39}K^+$ and $^{41}K^+$ ion (natural ratio) to $^{42}K^+$ ion amounts to ca 2.3‰ in 0.01 to 0.1 molar solution of KNO_3 at 25°C. This difference is also found in the transference numbers of the K^+ ion determined this way. (auth)

23468 TENTATIVE INTERPRETATION OF THE ULTRAVIOLET SPECTRUM OF XENON DIFLUORIDE. Julius Israéli (Hebrew Univ., Jerusalem). Bull. Soc. Chim., France, No. 3, 649(Mar. 1964). (In French)

The ultraviolet spectrum of XeF_2 is explained on the basis of a model proposed by Walsh (J. Chem. Soc., 2266 (1953)). (D.C.W.)

23469 TENTATIVE INTERPRETATION OF THE ULTRAVIOLET SPECTRUM OF XENON TETRAFLUORIDE. Julius Israéli (Hebrew Univ., Jerusalem). Bull. Soc. Chim., France, No. 3, 649-50(Mar. 1964). (In French)

An explanation of the ultraviolet spectrum of XeF_4 is presented. (D.C.W.)

23470 DEUTERIUM-HYDROGEN EXCHANGE BETWEEN WATER AND SILK FIBROIN. John L. Morrison (Ontario Research Foundation, Toronto). Can. J. Chem., 42: 1009-15(May 1964).

A gravimetric method for measuring deuterium-hydrogen exchange between light and heavy waters and macromolecular solids was applied to the fibrous protein, silk fibroin (Bombyx mori). The accessibility of the protein to water vapor can be estimated from the amount of exchange, and it appears to be related to the amorphous regions of the fiber. A comparison of the amount of exchange with the water monolayer content as obtained from the adsorption isotherm and the equilibrium evaporation technique suggests that the water molecules use the polar side chains of the amino acid residues as the sites of primary adsorption. (auth)

23471 CO-ORDINATION COMPLEXES OF GROUP(IV) HALIDES. PREPARATION AND INFRARED SPECTRA OF THE COORDINATION COMPOUNDS OF TITANIUM TETRACHLORIDE, TITANIUM TETRABROMIDE, ZIRCONIUM TETRACHLORIDE, TIN TETRACHLORIDE, AND BORON TRICHLORIDE WITH ETHYL CYANOACETATE AS LIGAND. Sumer Chand Jain and Roland Rivest (Univ. of Montreal). Can. J. Chem., 42: 1079-83(May 1964).

Co-ordination compounds between ethyl cyanoacetate and boron trichloride, titanium tetrabromide, and tetrachlorides of titanium, zirconium, and tin were prepared. The analytical results indicate that under similar experimental conditions, 1 : 1 addition compounds are obtained in each case. On the basis of infrared spectra it was postulated that the compounds obtained are six-membered ring chelates, satisfying the most common co-ordination number six for the elements of group IV. (auth)

23472 CHEMISTRY OF WATER SOLUTIONS OF ZIRCONIUM. Rostislav Caletka (Inst. for Nuclear Research, Czechoslovak Academy of Sciences, Řež). Chem. Listy, 58: 349-76(Mar. 1964).

A review was made of the chemistry of water solutions of Zr, and certain parts of the chemistry of Hf. Main attention is given to hydrolysis, polymerization, and formation of complexes. Full description of the formation of the unsoluble hydroxide is presented. Precipitation of Zr, colored compounds, and complexes suitable for spectrophotometric determination are mentioned. Microanalysis of Zr is discussed. Complexes with anions F, SO_4, Cl, NO_3, ClO_4, and C_2O_4 are described. Constants of stability of various compounds are tabulated. Discrepancies found in the literature are discussed. 236 references are included. (OTS)

23473 PREPARATION AND STUDY OF NEW URANYL AND TETRAVALENT URANIUM SALTS. COMPARATIVE POLAROGRAPHIC REDUCTION OF THE HALOGENIDES, URANYL ACETATE, AND TETRAVALENT URANIUM. Michel Lamisse, Robert Heimburger, and Raymond Rohmer (Institut de Chimie, Strasbourg). Compt. Rend., 258: 2078-80(Feb. 17, 1964). (In French)

In order to stabilize uranyl halogenides and, in particular, uranyl iodide that is decomposed at room temperature, the compounds $UO_2I_2 \cdot 4(DMF)$, $UO_2Cl_2 \cdot 3(DMF)$, $UCl_4 \cdot (DMF)$, and $UI_4 \cdot 4(DMF)$, DMF is dimethylformamide, were prepared. The polarographic study of these uranium halogenides and of uranyl acetate permitted the determination of the effect of the anion on the reduction mechanism at the mercury drop electrode. (tr-auth)

23474 PARAMAGNETIC RESONANCE IN IRRADIATED $Sr(NO_3)_2$. SINGLE CRYSTAL. K. Zdánský and Z. Sroubek (Inst. of Radio Engineering and Electronics, Czechoslovak Academy of Sciences, Prague). Czech. J. Phys., 14: 121-9(1964).

Paramagnetic resonance absorption of centers with spin $\frac{1}{2}$ centered about $g \doteq 2$ is reported in gamma-irradiated single crystals of $Sr(NO_3)_2$. At room temperature four centers are detected that appear to exhibit axial symmetry about the [111] crystal direction. Two of the observed centers have a resolved hyperfine structure of ^{14}N. This hyperfine structure and axial symmetry of the centers indicate that they could be irradiation products of the nitrate ion. To find the number of trapped electrons, a simplified calculation of the molecular orbitals of planar and pyramidal NO_3 is carried out. Centers with a resolved hyperfine structure are then identified as pyramidal NO_3^- and a NO_2 molecule rotating about the [111] direction. Two centers without hyperfine structure are not identified exactly. (auth)

23475 A STUDY OF THE CONDITIONS FOR THE FORMATION OF VARIOUS MODIFICATIONS OF URANIUM TRIOXIDE. L. M. Vidavskii, E. G. Lavut, L. M. Kovba, and E. A. Ippolitova (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 154: 1371-3(Feb. 21, 1964). (In Russian)

On oxidizing U_3O_8 under oxygen pressure over a wide range of temperature, it was possible to form the hexagonal α-UO_3, the monoclinic γ-UO_3, the cubic δ-UO_3, and also β- and ϵ-UO_3 phases, whose structures were not established. The experimental data showed that U_3O_8 is oxidized more rapidly to α-UO_{3-x} than α-UO_{3-x} is further oxidized to UO_3. Apparently the defect oxide $UO_{2.9}$ has a low reactivity. The ϵ-UO_3 phase is formed from U_3O_8 under oxygen pressure below 440 to 450°C, and below 350°C with the use of ozone or NO_2 as oxidizing agents. It was found that ϵ-UO_3 is triclinic with $a = 4.002$, $b = 3.841$, $c = 4.165$, $\alpha = 98°17'$, $\beta = 90°33'$, and $\gamma = 120°28'$. The x-ray density is 8.73, and the pycnometric value is 8.54. Thus, ϵ-UO_3 has a distorted U_3O_8 structure. The principal phase form is α-UO_3 on oxidizing U_3O_8 or α-UO_{3-x} under oxygen pressure at 450 to 550°C. The β- and γ-UO_3 phases occur as impurities to the ϵ- and α-modifications. It was found that β-UO_3 has a rhombic subcell with $a = 6.866$, $b = 3.906$, and $c = 7.14$, which are close to the lattice parameters of ammonium diuranate, but the lattice parameters of the true β-UO_3 cell could not be established. The structure of the initial uranium compound, the calcining temperature, and the heating rate have an effect on the type of UO_3 modification that is formed. (TTT)

23476 THE REACTIVITY OF NOBLE GASES. A NEW METHOD OF PREPARING XeF_2. V. M. Khutoretskii and V. A. Shpanskii. Dokl. Akad. Nauk SSSR, 155: 379-80 (Mar. 11, 1964). (In Russian)

Most of the methods of preparing various xenon fluorides require a high temperature and pressure, and an excess of fluorine. It is shown that XeF_2 can be formed from its element with the use of pressure at room temperature with the evolution of heat (a very preliminary value for the reaction heat is 40 to 60 kcal/mol.) Sometimes an explosion takes place. A vessel with a volume of 80 ml was pressurized with F_2 to 18 atm (2.17 g), and then xenon was introduced to a pressure of 35 atm (6.81 g). The pressure immediately increased, and then fell off to 8 atm. A residue of 6.70 g of a solid remained after removing the unreacted gases. Hydrolysis of the residue with 0.1N NaOH showed that the sample was XeF_2. The reaction proceeded more gradually in a vessel with a volume of 30 ml. The pressure decreased by a factor of two over a period of a few days. The reaction rate became insignificant at a pressure of 8 to 12 atm. It was concluded that it may be possible to synthesize compounds such as $XeCl_2$, XeO, KrF_2, etc. under these conditions. (TTT)

23477 THE EFFECT OF D_2O ON THE PHYSICAL PROPERTIES OF WHEAT GLUTEN. V. L. Kretovich and A. B. Vakar (Bakh Inst. of Biochemistry, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 155: 465-7 (Mar. 11, 1964). (In Russian)

It is believed that the physical properties of wheat gluten depend significantly on the presence of hydrogen bonding in the gluten protein. In organic compounds, which are highly associated by hydrogen bonding, deuteration leads to an increase in the association energy, and this change in energy is reflected in the physical properties of the gluten. To investigate this point, two lyophilized samples of gluten (1.5 gram each) were treated with 3.0 ml of distilled water and with 3.0 ml of 99.8% D_2O for 1 hour at 220°C. The stretching of the gluten with a 5 gram load was then measured in water at 30°C. Treatment with D_2O led to a noticeable decrease in the amount of stretching for three types of wheat gluten. In all cases the strength of the deuterated gluten increased. The weaker the initial gluten, the greater the increase in strength of the deuterated gluten. The stretching decreased by 59.4, 66.0, and 77.4% respectively for the strong, normal, and weak glutens which were deuterated. Deuteration can be used to investigate quantitatively the role of hydrogen bonding in determining the elastic properties of gluten, collagen, myosin, and fibroin. (TTT)

23478 ORTHOPHOSPHATE OF THORIUM. V. V. Deshpande and V. D. Damani (Atomic Energy Establishment, Trombay, India). J. Indian Chem. Soc., 41: 89-90 (Jan. 1964).

In attempts to prepare thorium phosphate tetrahydrate, the influence of pH and precipitation temperature was studied. It was found that the best conditions for obtaining an easily filtrable precipitate are to precipitate from a hot thorium nitrate solution containing an electrolyte (8% w/v ammonium nitrate) at pH 2.0 and boiling the solution after addition of H_3PO_4 for one minute. The composition of the sample obtained was fixed at $Th_3(PO_4)_4 \cdot xH_2O$. It was concluded that thorium orthophosphate, as prepared by the wet method is a white gel containing varying amounts of water, and that no compound of the tetrahydrate composition is formed even as an intermediate. (P.C.H.)

23479 THE DECOMPOSITION PRESSURE OF BORON CARBIDE AND THE HEAT OF SUBLIMATION OF BORON. D. L. Hildenbrand and W. F. Hall (Philco Corp., Newport Beach, Calif.). J. Phys. Chem., 68: 989-93(May 1964).

The boron decomposition pressure over boron carbide, B_4C, was measured by the torsion–effusion method in the range 2350 to 2615°K. A small hole-size effect indicates a condensation coefficient of roughly 0.07 for B(g) on $B_4C(s)$. The heat of dissociation of B_4C to B(g) and C(graphite) at 298°K was derived as 138.7 ± 1.2 kcal/mole of B from a third-law analysis of the vaporization data. From this result, the heat of sublimation of B at 298°K was evaluated as 135.7 ± 1.3 kcal/mole. An approximate value of 171 kcal/mole was obtained for the heat of formation of $BC_2(g)$ at 298°K. (auth)

23480 ION EXCHANGE IN CONCENTRATED ELECTROLYTE SOLUTIONS. III. ZEOLITE SYSTEMS WITH SALTS OF GROUP I AND II METALS. Stanley Bukata and Jacob A. Marinsky (State Univ. of New York, Buffalo). J. Phys. Chem., 68: 994-1000(May 1964).

The selectivity coefficients for the ion exchange of Cs with Na A-zeolite, C and Na with K A-zeolite, and Na and B with Ca A-zeolite were determined in dilute and concentrated solutions. The exchanging ions were at radioactive tracer level concentrations so that the fraction of the exchanged ion of the zeolite was essentially unity in both the resin and external liquid phases. Quantitative treatment of the observed data was accomplished by assuming that the zeolite phase may be treated as a highly concentrated electrolyte solution having only one diffusible ion and as a cross-linked network that exerts a pressure on the internal solution phase. The special properties of the zeolite, rigidity and resistance of electrolyte incursion, facilitate the treatment and permit the accurate prediction of selectivity at any external electrolyte concentration of two mobile counter ions at micro- and macroconcentration levels, respectively, on the basis of one selectivity measurement if the thermodynamic properties of the mixed electrolyte in the aqueous phase are known. Conversely, in the absence of such thermodynamic data, activity coefficients of the trace component can be computed from the experimentally determined selectivity coefficients. (auth)

23481 POLYFUNCTIONALITY AND EQUILIBRIUM SELECTIVITY COEFFICIENT OF ION-EXCHANGE SYSTEM. REACTION OF ALKALI METAL CATIONS WITH PHOSPHORIC ACID RESINS. H. Ti Tien (Northeastern Univ., Boston). J. Phys. Chem., 68: 1021-5(May 1964).

The equilibrium selectivity coefficients for the alkali metal cations for polymers containing strongly acidic groups follow the Hofmeister series. The order is inverted, however, for polymers having weakly acidic groups. Using phosphoric acid resins, the order of selectivity is shown to be a function of pH of the media used in the exchange reactions. The order of equilibrium selectivity coefficients at pH 6.7 and 8.5 is Cs > Rb > K > Na > Li. At pH 10 the order is Cs > Rb > K > Li > Na, whereas at pH 12.6 the order of affinity is quite different, being Li > Na > Rb ≃ Cs > K. The reasons for these inversions are advanced. An equation is presented that enables one to predict the orders of selectivity for such polyfunctional systems. A possible application of this phenomenon is also indicated. (auth)

23482 THE DECOMPOSITION PRESSURE OF PLUTONIUM NITRIDE. W. M. Olson and R. N. R. Mulford (Los Alamos Scientific Lab., N. Mex.). J. Phys. Chem., 68: 1048-51(May 1964). (LADC-6022)

Decomposition pressures for the reaction $PuN(s) \rightarrow Pu(l) + 0.5N_2(g)$ in the temperature range 2290 to 2770° are reported, and experiments that define some of the properties and methods of preparation of PuN are described. An equation, $\log p(atm.) = 8.193 - (29.54 \times 10^3)/T + 11.28 \times 10^{-18}T^6$ (T in °K), was found to fit the variation of the decomposition pressure with temperature over the above range. (auth)

23483 A SPECTROPHOTOMETRIC STUDY OF THE GASEOUS EQUILIBRIUM BETWEEN CADMIUM AND CADMIUM(II) CHLORIDE. Buddy L. Bruner and John D. Corbett (Ames Lab., Ames, Iowa). J. Phys. Chem., 68: 1115-21(May 1964). (IS-766)

A Beckman DU spectrophotometer was modified to permit investigation of gaseous equilibria at high temperatures, and the absorption spectra of the $Cd-CdCl_2$ system and its components were measured between 545 and 780°C. The mixture displays new bands due to the monochloride in addition to the transitions found with the pure components. ΔH°_{1000} for the reaction $Cd(g) + CdCl_2(g) = 2CdCl(g)$ was found to be 34.15 ± 0.5 kcal/mole and, with the third-law entropy change, ΔF°_{1000} is 23.8 ± 0.5 kcal/mole. Utilizing the solubility data for Cd in $CdCl_2(l)$, 83.9 and 32.6 kcal/mole were obtained for ΔH°_{1000} and ΔF°_{1000}, respectively, of the presumed reaction $Cd_2Cl_2(l) = 2CdCl(g)$. Values of 2.11 ± 0.03 and 0.027 ± 0.01 ev for D°_0 of CdCl and Cd_2, respectively, were also obtained. Analysis of the CdCl vibrational bands yielded 334.5/cm for ω_e'' and 1.3/cm for $x_e''\omega_e''$ of the $^2\Sigma$ ground state, and 397/cm for ω_e' and 0.9/cm for $x_e'\omega_e'$ of the $^2\Pi_{1/2}$ excited state. The 3181-Å band was not observed and its previous assignment to CdCl was concluded to be erroneous. (auth)

23484 THERMODYNAMICS OF SOLUTIONS OF DEUTERIUM CHLORIDE IN HEAVY WATER FROM 5 TO 50°. Robert Gary, Roger G. Bates, and R. A. Robinson (National Bureau of Standards, Washington, D. C.). J. Phys. Chem., 68: 1186-9(1964).

The standard emf of the cell Pt; $D_2(g)$ at 1 atm, DCl in D_2O, AgCl; Ag was determined from 5 to 50°C. At 25°C the standard emf is lower by 9.78 mv (on the molality scale) or 4.31 mv (on the mole fraction scale) than the standard emf of the corresponding cell with a hydrogen electrode and a solution of hydrochloric acid in ordinary water. Thermodynamic quantities were calculated for the reaction $\frac{1}{2}D_2(g) + HCl(in\ H_2O) = \frac{1}{2}H_2(g) + DCl(in\ D_2O)$. At 25°C, ΔG° is 418 joules $mole^{-1}$, ΔH° is −611 $joules^{-1}$, and ΔS° is −3.5 joules $deg^{-1}mole^{-1}$, when all four substances are in the standard state on the mole fraction scale. The mean ionic activity coefficient and relative partial molal enthalpy of DCl at molalities from 0.01 to 0.05 in heavy water were obtained and compared with those for HCl in H_2O. The activity coefficient of DCl in D_2O was slightly smaller than that of HCl in H_2O at the same molality; at m = 0.05, t = 25°, the difference in $\log \gamma_\pm$ is 0.0022. (auth)

23485 THE KINETICS OF REDUCTION OF NEPTUNIUM(VI) BY VANADIUM(III) IN PERCHLORIC ACID. J. C. Sheppard (General Electric Co., Richland, Wash.). J. Phys. Chem., 68: 1190-3(May 1964). (HW-SA-3157)

The rate law for the reduction of neptunium(VI) by vanadium(III) in perchloric acid obeys the expression, $rate = [Np(VI)][V(III)]\{k + k'/[H^+]\}$. At 25°C and at an ionic strength of 2.0, the values for k and k′ are 6.3 × 1.2 $\underline{M}^{-1}$ sec^{-1} and 20.3 × 0.5 sec^{-1}, respectively. The corresponding energies and entropies of activation are 18.6 × 1 kcal/mole and 5 eu for the hydrogen ion concentration independent path and 22 × 4 kcal/mole and 19 eu for the hydrogen ion concentration dependent path. (auth)

23486 ELECTRICAL CONDUCTANCE AND DENSITY IN MOLTEN MOLYBDENUM(VI) OXIDE–ALKALI (LITHIUM, POTASSIUM) MOLYBDATE SYSTEMS. Kelso B. Morris and Press L. Robinson (Howard Univ., Washington, D. C.). J. Phys. Chem., 68: 1194-1205(May 1964).

Electric conductance and density were determined as functions of temperature for the two fused binary molybdate systems, $K_2MoO_4-MoO_3$ and $Li_2MoO_4-MoO_3$. Data for the two properties in both systems cover temperatures that range up to at least 100° above the melting point for each composition. For the single components, the ranges for specific conductances, in ohms/cm, are 1.211 at 931.0° to 1.302 at 997.8°C for K_2MoO_4; 4.017 at 790.6 to 6.761 at 939.0°C for Li_2MoO_4; and 0.685 at 823.8 to 0.719 at 820.9°C for MoO_3. Ranges for the densities, in g/cm^3, are 2.479 at 935.0 to 2.450 at 988.3°C for K_2MoO_4; 2.888 at 781.2 to 2.802 at 963.4°C for Li_2MoO_4; and 3.206 at 828.2 to 3.083 at 918.0°C for MoO_3. When conductances for the first system, $K_2MoO_4-MoO_3$, were compared at corresponding temperatures that represent a fixed number of degrees above the melting points, resemblance was observed between the conductance–composition diagram and the phase diagram for this system. A conductance–composition plot for the second system, $Li_2MoO_4-MoO_3$, in terms of the more familiar polytherms is also similar to the phase diagram for this system. The two kinds of isotherms together with references to the observations of others suggest strongly that correlations may exist between conductance–composition diagrams and the phase diagrams for many molten binary systems. An explanation for the variation of conductance with composition in both systems is based on the nature and relative contributions of the constituent ionic species suggested by the phase diagram. Average activation energies, based on specific conductances, for the single substances and Na_2MoO_4 at corresponding temperatures that are 100° above the melting points decrease in the order $Li_2MoO_4 > Na_2MoO_4 > K_2MoO_4 > MoO_3$ or $MoO_2^{2+} \cdot MoO_4^{2-}$. (P.C.H.)

23487 POLARIZABILITY OF THE CLOSED-CAGE BORON HYDRIDE $B_{10}H_{10}^{-2}$. Alexander Kaczmarczyk and Gerald B. Kolski (Dartmouth Coll., Hanover, N. H.). J. Phys. Chem., 68: 1227-9(May 1964).

The polarizability of $B_{10}H_{10}^{2-}$, which is very large, was first determined and the contribution of the ten electron-pair covalent B-H bonds from the total value for $B_{10}H_{10}^{2-}$ to estimate the polarizability of the cage proper. A value of 8.9 Å was obtained. This value corresponds to an apparent radius of 2.07 Å for the proposed model in which the ten borons form a conducting sphere on which the 22 cage electrons are relatively free to move under the influence of an electric or magnetic field. It is pointed out that the B-H bonds in $B_{10}H_{10}^{2-}$ are much less hydridic than those in BH_4^- and also that the effects of a −2 charge are distributed over ten such bonds. (P.C.H.)

23488 DECOMPOSITION PRESSURE OF $TcZn_6$. Ewald Veleckis and Irving Johnson (Argonne National Lab., Ill.). J. Phys. Chem., 68: 1257-8(May 1964).

The free energy of formation of $TcZn_6$ was determined from the measurement of the vapor pressures of zinc in equilibrium $TcZn_6(s) = Tc(s) + 6Zn(g)$ by the Knudsen effusion method. Data are tabulated. (P.C.H.)

23489 NUCLEI FORMATION AND CRYSTAL GROWTH IN THE PREPARATION OF NUCLEAR TRACK EMULSIONS. E. Klein and E. Moisar (Wissenschaftliches Photographisches Labor der Agfa, Leverkusen, Ger.). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 132-40(1963). (In German)

Preparation methods affecting the characteristics of nuclear emulsions were studied. Nuclei formation, dissolution for "Ostwald maturing," and material accumulation on existing crystals were investigated in the formation of solid phases from dissolved components. Changes of particle size and radius with time in a silver iodide sol, dependence of solubility and grain size on silver concentration, and other parameters of the emulsions were determined. (M.C.G.)

23490 GRAIN FORMATION AND PHOTOGRAPHIC PROPERTIES OF NUCLEAR TRACK EMULSIONS. E. Moisar (Wissenschaftliches Photographisches Labor der Agfa, Leverkusen, Ger.). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 141-8(1963). (In German)

Grains of a silver bromide emulsion exposed to a strong reductive surface treatment were studied in order to compare the results with the effects of light and electrons. Image formation is shown in graphs. (M.C.G.)

23491 CONTROLLED OSTWALD MATURING OF PHOTOGRAPHIC EMULSIONS. W. Markocki (Technical Univ., Breslau, Poland) and W. Romer. Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 149-61 (1963). (In German)

Investigations were made to develop a method for the growing of silver halide crystals suspended in gelatin solutions. The Ostwald maturing method is based on reducing the energy of the system by reducing the phase boundaries in crystal growth. Processes in this method and results achieved are described. Principles of controlled Ostwald maturing that lead to monodispersed suspensions in ammonia-containing emulsions are outlined. Examples are described. (M.C.G.)

23492 NEW PREPARATION METHODS FOR NUCLEAR EMULSIONS. Wladyslaw Markocki (Technical Univ., Wroclaw, Poland). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 162-8(1963). (In German)

Various methods of emulsion preparation were reviewed. The method of controlled Ostwald maturing for preparation of sufficiently concentrated nuclear emulsions without separation of the solid phase was investigated. (M.C.G.)

23493 ON THE GRAIN GROWTH IN NUCLEAR TRACK EMULSIONS IN THE CASE OF AMMONIA MATURING. A. Narath and W. Graesser (Technische Universität, Berlin). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 169-77(1963). (In German)

Preparation of nuclear emulsions by maturing with ammonia was studied. The dependence of grain size and distribution on the ammonia and silver concentrations was determined. The influence of various emulsion gelatin compositions on ammonia maturing was investigated. (M.C.G.)

23494 ON AN ARRANGEMENT FOR CONTINUOUS PREPARATION OF NUCLEAR TRACK EMULSIONS. A. Narath and H. Schieferdecker (Technische Universitat, Berlin). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 178-85(1963). (In German)

The continuous preparation of photographic emulsions by precipitation from a mixture of silver nitrate, potassium bromide, and gelatin is described. The volume of the mixing apparatus amounts to only 1 ml. The average tarrying time of the individual grains in the mixer is therefore, in the case of a relatively small throughput, so small that a back-mixing of the precipitated reaction products with the new arrivals practically does not occur. The equipment and properties of the emulsion obtained are described. (M.C.G.)

23495 PROPERTY IMPROVEMENTS FOR NUCLEAR EMULSIONS BY INCORPORATION OF SURFACE-ACTIVE MATERIAL OF THE HOMOLOGOUS SERIES OF SODIUM SALTS OF SULFOSUCCINIC ACID ESTERS. T. A. Kalinkina, V. A. Mylzeva, O. K. Smirnov, and V. M. Uvarova (NIKFI, Moscow). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 186-97(1963). (In German)

Mechanisms of the interactions of materials of the homologous series of sodium salts of sulfosuccinic acid esters with gelatin to improve the characteristics of nuclear emulsions were investigated. Effects of the surface-active agents on viscosity of the gelatin solution and mechanical layer properties were determined. (M.C.G.)

23496 CENTRIFUGATION AND OTHER TREATMENTS FOR IONOGRAPHIC GELATINE. J. Demers and P. Demers (Univ. of Montreal). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962. 198-202 (1963). (In French)

The preparation and processing of ionographic emulsion is discussed, with particular emphasis on the precipitation and centrifugation processes that may be used. (T.F.H.)

23497 STUDY OF THE CHEMICAL RIPENING OF R EMULSION. D. M. Samoylovich, I. V. Ardachev, E. S. Barinova, R. V. Ryabova, and O. P. Joukhnovskaya (Inst. of Atomic Energy, Moscow). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 203-9(1963). (In French)

The conditions for preparation of NIKFI-R emulsion are outlined. The effects of the temperature, duration, etc., of chemical ripening on the sensitivity of the emulsion are studied. (T.F.H.)

23498 PROPERTIES OF FINE-GRAIN NUCLEAR EMULSIONS IN THEIR DEPENDENCE ON THE pAg AND THE TEMPERATURE OF THE EMULSIFICATION PROCESS AND OF THE FIRST RIPENING. E. V. Fadina, N. R. Novikova, N. A. Perfilov, and V. I. Zakharov (Inst. of Radium, Leningrad). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 210-20(1963).

Desirable preparation techniques and final properties for fine-grained nuclear emulsions are determined experimentally. The use of Au sensitization for this type of emulsion is studied. (T.F.H.)

23499 STUDY OF THE MECHANISM OF SENSITIZATION OF NUCLEAR EMULSIONS BY CERTAIN DYESTUFFS. A. L. Kartuzhanskii and L. I. Shur (Inst. of Radium, Leningrad). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 221-30(1963).

Studies are made of the sensitization of nuclear emulsions by dyes containing p-dimethylaminostyryl groups. The properties of the emulsions thus formed are also determined. (T.F.H.)

23500 2,2′-DIPYRIDYL COMPLEXES OF RARE EARTHS. I. PREPARATION, INFRA-RED AND SOME OTHER SPECTROSCOPIC DATA. S. P. Sinha (Cyanamid European Research Inst. Cologny, Geneva). Spectrochim. Acta, 20: 879-86(May 1964).

Complexes of rare earths with 2,2′-dipyridyl of the type $[M(Dip)_2(H_2O)_n]^{3+} X_3$ (where M^{3+} = Pr, Sm, Eu, Gd, Tb, Dy and Er; Dip = dipyridyl, x = Cl^- or No_3^- and n = no of water molecules) are described. Infrared studies with probable assignments are presented. The dipyridyl band at 990 cm^{-1} is shifted to higher frequency (~1010 cm^{-1}) in the chelates indicating the formation of a complex. Two new peaks between 1480-1500 cm^{-1} are observed in the spectra of all chelates. Preliminary observations on the fluorescence properties of the chelates are included. Sm(III) and Dy(III) chelates showed weak fluorescence. The characteristic line emission is present in Eu(III) and Tb(III) chelates. The fluorescence of the Gd(III) complex is due to the presence of minute Eu(III) and Tb(III) impurities, and the energy transfer from dipyridyl molecules bound to Gd(III) is quite effective. (auth)

23501 SPECTROPHOTOMETRIC STUDIES OF ELECTROLYTIC DISSOCIATION. PART 7. DISSOCIATION CONSTANTS OF SAMARIUM AND PRASEODYMIUM SULPHATES AND OF LANTHANUM THIOSULPHATE IN WATER. J. C. Barnes and C. B. Monk (University Coll. of Wales, Aberystwyth). Trans. Faraday Soc. 60: 578-83 (Mar. 1964).

From cation band shifts in the uv region, $10^4K_1(SmSO_4^+)$ = 2.9, and $10^4K_1(PrSO_4^+)$ = 4.3 (both ±15%) in water at 25°C were derived while shifts to the uv anion band give 10^3K_1 $(LaS_2O_3^+)$ = 1.0 – 1.3. (auth)

23502 CRYSTAL CHEMISTRY OF BERYLLIUM. Malcolm Ross (Geological Survey, Washington, D. C.). [1962]. Geological Survey Professional Paper 468. 34p. (GPO)

A compilation was made of the x-ray crystallography, chemistry, and crystal chemistry of all the known minerals containing essential amounts of beryllium. These minerals are: aminoffite, barylite, bavenite, bazzite, bearsite, bertrandite, beryl, beryllite, beryllonite, beryllosodalite, bityite, bromellite, chkalovite, chrysoberyl, danalite, epididymite, euclase, eudidymite, faheyite, gadolinite, gelbertrandite, genthelvite, gugiaite, hambergite, harstigite, helvite, herderite, hsianghualite, hurlbutite, karpinskyite, leucophanite, meliphanite, milarite, moraesite, phenakite, rhodizite, roschérite, spherobertrandite, swedenborgite, taaffeite, tengerite, trimerite, and väyrynenite. The x-ray crystallography and crystal structure of the following inorganic and organic beryllium compounds are also given: $Be(H_2O)_4SO_4$, β-$Be(OH)_2$, $BeSO_4$, $BeGeO_4$, BeS, BeSe, BeTe, $BeSiN_2$, $BeCl_2$, $Be(CH_3)_2$, $Be_4O(CH_3COO)_6$, $BeC_{32}H_{16}N_8$, and the beryllium fluorides. In all but one compound (beryllium phthalocyanine) beryllium is reported to be tetrahedrally coordinated. In beryllium phthalocyanine Be is in planar coordination. A summary of the bond distances between beryllium and the coordinating anions is presented. The average beryllium–oxygen bond distance in those structures believed to accurately determined is 1.636 A: the average Be–OH bond distance is 1.650 A. (auth)

23503 THE ROLE OF RARE EARTH OXIDES IN THE STABILIZATION OF CUBIC ZIRCONIA. L. L. Fehrenbacher, L. A. Jacobson, and C. T. Lynch (Air Force Materials Lab., Wright-Patterson AFB, Ohio). 26p. (CONF-405-11)

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

The phase stabilization of high purity (99.8%) hafnia-free monoclinic ZrO_2 with additions of various rare earth oxides, especially the type-C cubic rare earth oxides, was investigated. Experimental observations of the resultant phases and properties were compared in terms of solid solution theory parameters such as valency difference, relative ionic size, compressibility, and electronegativity. Ceric, La, Nd, Dy, and Yb oxides (99.9% purity) were added to zirconia over a range of zirconia based compositions. The batches were thoroughly mixed, cold-pressed into cylindrical compacts at 25,000 psi, and fired in air, inert, and vacuum environments over a wide range of times (15 min to 200 hr) and temperatures (1300 to 2400°C). The heat-treated specimens were studied with respect to their crystal structure, thermal expansion, and differential thermal analysis characteristics. Ytterbia and dysprosia additions formed distorted fluorite (fcc) zirconia solid solutions readily, requiring 5 mole % for complete cubic stabilization. Neodymia and lanthana–zirconia compositions formed much narrower ZrO_2 solid solution regions than the Yb_2O_3 and Dy_2O_3 samples, and with additions of 30 to 40 mole %, a distinctly ordered cubic pyrochlore structure appeared. The solid state reactions in the CeO_2-ZrO_2 system were found to be strongly dependent on atmosphere in contrast to the environmental insensitivity of the Yb_2O_3, Dy_2O_3, Nd_2O_3, and $La_2O_3-ZrO_2$ compositions. The solid solution structures of the rare earth oxide–zirconia systems correlated well with predictions based on the physical and electrochemical factors. Thus, the oxides with the most favorable parameters (ionic size, electronegativity, and compressibility), ytterbia and dysprosia, were the most potent zirconia stabilizers. (auth)

23504 THE PHASE TRANSITION REGION OF $PrO_{1.5}$. D. S. Chapin, M. C. Finn, and J. M. Honig (Massachusetts Inst. of Tech., Lexington). 15p. (CONF-405-9)

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

The $PrO_{1.5}$ type-C to type-A phase transition was investigated by the analysis of the x-ray line spectra on quenched samples. Quartz capillaries were outgassed at 1000°C and filled with freshly prepared $PrO_{1.5}$ in vacuo. $PrO_{1.5}$ was found to exist in the cubic (C) form up to approximately 820°C. The cubic to hexagonal (A) transition occurred in the region 820 to 860°C. No evidence was found for the existence of a monoclinic (B) phase, or any other structure. Residual gases in the $PrO_{1.5}$ preparations by various investigators is believed to be responsible for variations in the results reported in the literature. (auth)

23505 ON PHASE EQUILIBRIA AND PHASE REACTIONS IN TbO_x-O_2 AND RELATED SYSTEMS. Bruce G. Hyde and LeRoy Eyring (Arizona State Univ., Tempe). 54p. (CONF-405-8)

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

A new isobaric study of the system TbO_x-O_2 was made. The experiments are described and interpreted. Results were correlated with those available on the related systems: PrO_x-O_2 and CeO_x-O_2. Some apparent anomalies were removed and the three systems were seen to be closely analogous. The many-ordered intermediate phases are members of an homologous series, R_nO_{2n-2}. In addition, the appearance of disordered stable phases and metastable pseudophases was interpreted in structural terms involving microheterogeneity. Some preliminary experiments suggest that the observed pseudo-phases are responsible for the appearance of hysteresis during phase transformation in these systems. The structural ideas were extended to yield a tentative explanation of the observed homology. (auth)

23506 CRYSTAL CHEMISTRY OF SOME RARE EARTH–GROUP VI COMPOUNDS. D. J. Haase, H. Steinfink, and E. J. Weiss (Univ. of Texas, Austin). 12p. (CONF-405-16)

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

The rare earth–group VI systems lanthanum–tellurium, neodymium–tellurium, erbium–tellurium, and erbium–selenium were investigated. The phase diagrams of these systems were determined; the crystal chemistry of the intermediate phases was investigated; and the physical properties, such as electric conductivity and Seebeck coefficient, are under investigation. It is not unexpected that the lanthanum– and neodymium–tellurium systems are similar with the exception of higher melting point temperatures for the neodymium compounds and the appearance of the compound Nb_2Te_5. The erbium–tellurium system differs considerably from the La and Nd systems and might be representative of phase diagrams for the heavy rare earth elements. The erbium–selenium phase diagram does not have a solid solution range for the 3 : 4 composition; the 1 : 3 composition is absent; and the 1 : 2 intermediate phase shows a phase transition. (auth)

23507 DYNAMIC DECOMPOSITION OF RARE-EARTH OXALATES. R. C. Ropp and E. E. Gritz (Westinghouse Electric Corp., Bloomfield, N. J.). 38p. (CONF-405-10)

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

Stable intermediates that form during dynamic decomposition of rare earth oxalates were elucidated by examining the reaction mechanisms that occur when the temperature is changed at a constant rate. Dynamic thermogravimetry was used to observe the complete thermal behavior of the systems, and differential thermal analysis was employed as an auxiliary method. Plateaus in weight loss under conditions of dynamic thermal change indicate the formation of the most stable intermediates. The results indicate that a different sequence of decomposition reactions can occur under dynamic thermal change compared to those reported for isothermal decomposition. (P.C.H.)

23508 ELECTROSTATIC ENERGY AND VALENCE BOND CONSIDERATIONS IN THE Th_3P_4 STRUCTURE. Forrest L. Carter (Westinghouse Electric Corp., Pittsburgh). 39p. (CONF-405-15)

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

The Th_3P_4 structure was considered from two different aspects, one purely electrostatic and the other from a valence bond approach employing half bonds. The Madelung constant of Th_3P_4 was calculated as a function of the phosphorous parameter x, according to the method of Felix Bertaut who employed the Patterson Function in an ingenious manner. The results indicate that the value usually assumed $(x = 1/12)$ is electrostatically unstable with the minimum at $x = 0.04$. A bidirectional orbital with an electron density having the symmetry C_{2v} was employed to discuss the formation of directed half bonds in the Th_3P_4 structure without resort to Pauling's concept of pivotal resonance. This gives the atom in the Th position a valence of four and the one in the P position a valence of three. These valences result in charge transfer in well-known compounds having the Th_3P_4 structure according to the representations $Ce_2^{-1}S_3^{+2/3}$, $Ce_3^{-4/3}S_4^{+1}$, and $Sb_3^{+1}Gd_4^{-3/4}$. The use of the bidirection bonds leads naturally to the concepts of a chemical valence bond and of a phase structure. Several possible phase structures are given for the Th_3P_4 compounds. Speculation is offered upon the possible relation between the valence bond and magnetic interactions. (auth)

23509 MIXED OXIDES OF THE TYPE MO_2 (FLUORITE)–M_2O_3. PART 2. NON-STOICHIOMETRY IN TERNARY RARE-EARTH OXIDE SYSTEMS. PART A. THE SYSTEM $CeO_2-Y_2O_3$. D. J. M. Bevan, W. W. Barker, and R. L. Martin. PART B. THE SYSTEMS $CeO_2-M_2O_3$ (M = La, Nd, Sm, Gd, Dy, Ho, Yb). D. J. M. Bevan, W. W. Barker, and T. C. Parks (Univ. of Western Australia, Nedlands). 23p. (CONF-405-18)

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

Equilibrium studies were made on the ternary systems $CeO_2-M_2O_3$ where M = Y, La, Nd, Sm, Gd, Dy, Ho, Yb. The system $CeO_2-Y_2O_3$ was examined more fully. The results confirm the existence of both the wide-range fluorite and C-type phases. Identical data were obtained for physical mixtures and coprecipitated samples of the same composition, and it is clear that there is reasonable agreement between the various sets of data, particularly in the type-C region. It is speculated that there may be some significance in the trend towards comparatively lower values of the fluorite-type phase parameter with increasing yttria content at the highest temperature (1600°C). The appearance of weak, diffuse type-C lines in the fluorite-type phase patterns were also observed. The results show that there is a well-defined miscibility gap under equilibrium conditions between the fluorite-type phase on the one hand and the C-type phase on the other. The diphasic region is defined at five temperatures (1100, 1400, 1500, 1600, and 1700°C) by the constancy of the parameters observed for both phases at different compositions within it. It is believed that the data for the last three temperatures refer to quenched, high-temperature, equilibrium states. Heating experiments on the samples are also discussed. (P.C.H.)

23510 PRASEODYMIUM-GROUP V COMPOUNDS. II. A THERMODYNAMIC STUDY OF THE NONSTOICHIOMETRIC PRASEODYMIUM BISMUTHIDE, $PrBi_{1-x}$ WITH A MASS SPECTROMETER. Karl A. Gingerich (Pennsylvania State Univ., University Park). 13p. (CONF-405-17).

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

The vaporization of praseodymium bismuthide, PrBi, was investigated by the Knudsen effusion-mass spectrometer technique. The Bi partial pressures for the Pr-rich boundary composition of the PrBi phase were obtained as a function of temperature. In the correlation of the Bi ion intensities to partial pressures two different approaches were used: silver calibration and evaporation of a weighed amount of sample. The partial Bi-decomposition pressure was measured over the temperature range of 1350 to 1610°K and can be expressed by the equation: $\log p_{(atm)}[Bi] = -21{,}711/T + 8.6218 \pm 0.0945$. From the second law treatment, the partial enthalpy of Bi-dissociation in kcal/mole was obtained as 99.35 ± 1.86. (auth)

23511 RESISTIVITY AND THERMOELECTRIC POWER AT LOW TEMPERATURES OF THE "TRI-RARE EARTH CARBIDES" OF Sm, Gd, Er, AND Dy. Robert Lallement (CEN, Fontenay-aux-Roses, France). 11p. (CONF-405-27)

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

Measurements were made on the resistivity and thermoelectric power of some rare earth carbides between 4°K and room temperature. It was found that the tri-rare earth carbides of Sm, Gd, Dy, and Er are magnetically ordered at low temperatures. Gadolinium carbide is ferromagnetic below 500°K, the other carbides are probably antiferromagnetic. The Neel temperatures are 30°K for Sm_3C, 80°K for Er_3C, and 170°K for Dy_3C, respectively. (P.C.H.)

23512 THE MAGNETIC SUSCEPTIBILITY OF $GdPO_4$, $TbPO_4$, AND $DyPO_4$. Franklin F. Y. Wang and R. S. Feigelson (Sperry Rand Research Center, Sudbury, Mass.). 12p. (CONF-405-26)

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

Magnetic susceptibility measurements were made on Gd, Tb, and Dy orthophosphates from 20 to 900°K using the Faraday method. At high temperatures, the molar susceptibility of $GdPO_4$, $TbPO_4$, and $DyPO_4$ follow the Curie-Weiss law, $X_m = C_m/(T-\theta)$. Curie constant, C_m, asymptotic Curie point (θ), effective magnetic moment, μ_{eff}, and Neel point, T_N, data are tabulated. Other magnetic properties are discussed. (P.C.H.)

23513 MAGNETIC SUSCEPTIBILITY OF SEVERAL RARE EARTH OXIDES. H. Hacker, Jr., M. S. Lin, and E. F. Westrum, Jr. (Univ. of Michigan, Ann Arbor). 22p. (CONF-403-25)

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

A careful study of the temperature dependence of the magnetic susceptibilities of the oxides of neodymium, gadolinium, dysprosium, holmium, erbium, and ytterbium was conducted throughout the range from 4.2 to 300°. Each of the compounds, with the exception of Gd_2O_3, showed an anomally of the type characteristic of crystalline field splitting of the ground state degeneracy of the free rare earth ion. A description of the susceptibility measurement system, which involves a mutual inductance scheme, is included, along with other experimental details. (auth)

23514 INVESTIGATION OF THE NATURE OF THE CHEMISORBED ACETATE ON PrO_2 PREPARED BY ACETIC ACID LEACHING. A. F. Clifford and K. J. Hughes (Purdue Univ., Lafayette, Ind.). 15p. (CONF-405-12)

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

Although the lattice constant for PrO_2 prepared by acetic acid leaching agrees with the accepted literature value, TGA and DTA studies indicate that some 1½% of material is lost exothermically around 175-185°C. The pure dioxide does not appear to undergo reduction endothermically until around 300°C. IR spectra show bound acetate and microanalytical analyses indicate about 0.75% C and too small a percentage of hydrogen to be determined. In an attempt to ascertain whether this is Pr(III) or Pr(IV) acetate, the impure dioxide was leached with glacial acetic acid and with sodium acetate in glacial acetic acid solutions for periods of time ranging from 10 minutes to 15 hours. The UV spectra showed only the characteristic Pr(III) peaks, 444, 469, and 482 mμ, and none of Pr(IV). Heating samples at 125°C in air did not remove the acetate, but heating at 185°C for 12-18 hours did. Along with the removal of acetate, there was a loss of oxidizing power, as shown by iodometric determinations, which corresponds reasonably well to the oxidation of the amount of acetate present. X-ray diagrams of the samples after removal of the acetate in vacuo at various temperatures up to 300°C were taken. The TGA analyses also show stable non-stoichiometric compositions of 1.88-1.89 and 1.85-1.86, which begin reduction around 400°C and 490°C, respectively; the latter being reduced to the familiar 1.83. (auth)

23515 THE STANDARD ENTROPIES OF THE AQUEOUS LITHIUM AND FLUORIDE IONS AND THE HEAT OF SOLUTION OF LITHIUM FLUORIDE. Clark C. Stephenson (Massachusetts Inst. of Tech., Cambridge), Harry P. Hopkins, and Claus A. Wulff. 10p. (CONF-322-13).

From American Chemical Society Production Technology of Np 237 and Pu 238, Denver, Jan. 1964.

The standard entropy of the aqueous lithium ion was calculated, from literature data for $LiCl \cdot H_2O$, as 2.5 ± 0.3 cal/mole °K, and a value of 3.0 ± 0.4 cal/mole °K based upon a calorimetrically measured heat of solution of LiF: $\Delta H^0_{298} = 1070 \pm 50$ cal/mole. The standard entropy of the aqueous fluoride ion was then calculated as −3.6 ± 0.2 cal/mole°K. (P.C.H.)

23516 NON-STOICHIOMETRY IN CeO_{2-x}. Michael Hoch and Hyo Sub Yoon (Univ. of Cincinnati). 17p. (CONF-405-13).

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

The oxygen pressure versus composition data on CeO_{2-x} was interpreted according to the defect model developed earlier, assuming either oxygen vacancies (which fitted the data better), or cerium interstitials. In both cases, a large defect interaction energy was obtained. To check this unexpected behavior, the ternary systems $CeO_2-Ce_2O_3-ThO_2$ and $CeO_2-Y_2O_3-ThO_2$ were investigated at 1200°C. CeO_2 and ThO_2 are completely miscible, and $CeO_{1.5}$ dissolves in ThO_2 up to 45 mole %. In each system, a large single phase cubic region with the fluorite structure connecting the single phase regions in the binary systems was expected. However, a large two-phase region was found where two defect fluorite structures based on CeO_2 and ThO_2 coexist. They become miscible at the CeO_2-ThO_2 line where the defect concentration is small. This behavior is explained by a rapid increase of the critical mixing temperature when the trivalent ion Ce^{3+} or Y^{3+} is added to the solution of two tetravalent ions. However, when a higher valent ion (U^{6+}) is added to two tetravalent ions, no demixing was observed. (auth)

23517 CHEMICAL AND PHYSICAL PROPERTIES OF SAMARIUM DICARBIDE. N. L. Jensen and C. J. Hoffman (Lockheed Missiles and Space Co., Palo Alto, Calif.). 13p. (CONF-405-14).

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

Samarium dicarbide was prepared by heating samarium sesquioxide with graphite. X-ray studies confirmed the tetragonal structure, and the lattice constants show that samarium is trivalent in the crystal. Magnetic studies show that no additional paramagnetism is conferred on the compound by the third valence electron, which indicates that the electron is not localized on the samarium ion. The electrical conductivity was found to approach that of samarium metal. Hydrolytic studies were made, and gases evolved on hydrolysis were analyzed by vapor-phase chromatography and infrared spectroscopy. The properties of samarium dicarbide were compared with the corresponding properties of calcium carbide. A model, which is consistent with the observed properties, was proposed for the ground-state electronic configuration of samarium dicarbide. (auth)

23518 STEREOCHEMISTRY OF THE ETHYLENEDIAMINETETRAACETATO COMPLEXES OF LANTHANUM AND OTHER RARE EARTH (III) IONS. J. L. Hoard, M. D. Lind, and Byung-kook Lee (Cornell Univ., Ithaca, N. Y.). 16p. (CONF-405-22)

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

Stereochemical results on the EDTA complexes of La, Nd, Gd, and Er come from structure determinations, utilizing three-dimensional x-ray data, of the crystalline EDTA chelates of empirical formulas, $HLaY \cdot 7H_2O$ and $KLaY \cdot 8H_2O$. Unit cell and space group data for a number of other salts in which the rare earth ion is Nd, Gd, or Er are also given. Essential isomorphism was indicated for all the rare earth salts studied. Isomorphism was indicated in open disregard of the usually decisive differences in the structural requirements of the Na^+, K^+, and NH_4^+ ions. It is hypothesized that when La^{3+} is replaced by Ce^{3+} in the complex anion, Ce^{3+} in turn by Pr^{3+}, etc., throughout the rare earth series, each step will see a general shrinkage of the anion; each such step, moreover, will see the M^{3+} ion move closer to the mean plane defined by the four oxygen atoms (O_c) complexed to M^{3+}. (P.C.H.)

23519 IMPROVEMENTS IN OR RELATING TO THE PURIFICATION OF HELIUM. Ronald Berry (to United Kingdom Atomic Energy Authority). British Patent 956,282. Apr. 22, 1964. Filed Sept. 23, 1960.

A He purification apparatus using both physical and chemical purifying steps is patented. The He is purified by the following sequence: drying; passing through a refrigerated molecular sieve; being contacted with a metal getter and then with an oxidizing agent; and drying again by passing through 2 molecular sieves, the first at room temperature and the second refrigerated. The apparatus has been used to reduce the impurities in commercially available He gas to a degree less than 1.0 volumes/million. (M.P.G.)

23520 PROCESS FOR THE MANUFACTURE OF BORON-FREE GRAPHITE. (to Deutsche Erdol AG). British Patent 957,313. May 6, 1964. Priority date Nov. 14, 1959, Germany.

A process for the manufacture of B-free graphite suitable for reactor moderators is patented. Crude graphite is finely ground and then combined with water to form a paste-like slurry. The slurry is kneaded with a water-immiscible oil to produce phase separation. The aqueous mineral phase is removed with water, and the oil is removed from the graphite-oil phase by a solvent. The residual mineral constituents in the graphite are removed with hydrofluoric acid or a mixture of hydrofluoric and sulfuric acid, and the acid is then removed by washing. With this process the B content of the final product is reduced to at most 10^{-7} part by weight of B in one part by weight of graphite. The residual mineral content can be reduced to 0.02 to 0.01 wt %. (M.P.G.)

23521 PLUTONIUM COMPOUNDS. Lewis Eric Russell (to United Kingdom Atomic Energy Authority). U. S. Patent 3,132,924. May 12, 1964. Priority date Sept. 1, 1959, Great Britain.

Only Ba, Al, V, Cr, and Mn will form compounds with the formula $PuMO_3$ and a perovskite structure. With the exception of Mn, all these metals have low neutron cross sections and hence the $PuMO_3$ compounds containing these metals may be used as a reactor fuel material. The compounds may be prepared at 1300 to 1650°C, and examples of their preparation are given. (D.L.C.)

23522 THE MEASUREMENT OF VOLUME DIFFUSION BY THE METHOD OF AUTORADIOGRAPHY. T. J. Renouf (Univ. of Edinburgh). Phil. Mag. (8), 9: 781-95(May 1964).

The application of autoradiography to the measurement of volume diffusion is limited because of the difficulty in interpreting the effects of the energy of the radiations, the scattering and absorption properties of the specimen, and other complicating factors. A general method of interpretation is described in which the effects of these factors are suitably combined into a single function that is determined by one experiment. The method is applied by matching the experimental density trace of the diffusion zone with a density curve which is computed from a derived expression. As a trial of this treatment, the diffusion of ^{124}Sb into single crystals of copper was studied over the penetration range $10\ \mu < (Dt)^{1/2} < 150\ \mu$ and in the temperature range 560 to 896°C with specimens mounted singly and in a double sandwich-type arrangement. The results show good agreement with results obtained from mechanical sectioning, and the accuracies of the two methods are comparable. In the case of small penetrations at low temperatures, anomalously low values of the diffusion coefficient are noted. (auth)

23523 A NOTE ON THE MAGNETIC STRUCTURES OF RARE EARTH MANGANESE OXIDES. W. C. Koehler, H. L. Yakel, E. O. Wollan, and J. W. Cable (Oak Ridge National Lab., Tenn.). Phys. Letters, 9: 93-5(Apr. 1, 1964).

A model for the magnetic configuration of rare earth manganese oxides, based on ordering of the second kind of Hirone and Adachi, is described. Moment values obtained from neutron diffraction data for $ScMnO_3$, $LuMnO_3$, $TmMnO_3$, $ErMnO_3$, and $HoMnO_3$ are tabulated. (L.B.S.)

23524 ELECTRON SPIN RESONANCE STUDIES WITH SUPERCONDUCTING MAGNETS: THE SPECTRUM OF Dy^{3+} AND Sm^{3+} IN CaF_2. W. Low (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 134: A1479-82(June 15, 1964).

An electron spin resonance spectrometer was constructed using strong magnetic fields up to 46,000 G generated by a superconducting magnet. It is being used for the measurement of the magnetic properties of transition elements in ionic crystals such as small g factors, energy level separations up to 20 cm^{-1}, isotropic and anisotropic exchange terms in spectra of pairs of paramagnetic ions, spin-lattice relaxation times at high magnetic fields. The method is illustrated in the measurements of the energy level separation of $\Gamma_8-\Gamma_7$ levels of Dy^{3+} in CaF_2 which is found to be $7.3_5 \pm 0.2$ cm^{-1}; the g factors of the tetragonal spectrum of Sm^{3+} in CaF_2 which are found as $g_{||}$ 0.907 ± 0.01, $g_\perp = 0.544 \pm 0.015$. (auth)

23525 PARAMAGNETIC RESONANCE OF Yb^{3+} IN $CaWO_4$. U. Ranon (Israel Atomic Energy Commission, Yavne) and V. Volterra. Phys. Rev., 134: A1483-5(June 15, 1964).

Paramagnetic resonance of Yb^{3+} was observed in single crystals of $CaWO_4$ at 20°K and 3 cm. A tetragonal as well as two rhombic spectra were found. The tetragonal spectrum is fitted to an axial spin hamiltonian with $g_{||} = 1.058 \pm 0.002$, $g_\perp = 3.920 \pm 0.005$, $|^{173}A| = (77 \pm 1)10^{-4}$ cm^{-1}, $|^{173}B| = (285 \pm 1)10^{-4}$ cm^{-1}, $|^{173}P| < 2.10^{-3}$ cm^{-1}, $|^{171}A| = (279 \pm 3)10^{-4}$ cm^{-1}, $|^{171}B| = (1034 \pm 3)10^{-4}$ cm^{-1}. The rhombic spectra have the y and z axes in the {110} planes. One has the z axis at 6 ± 1° to the crystallographic c axis and $g_x = 3.012 \pm 0.005$, $g_y = 4.788 \pm 0.005$, $g_z = 0.975 \pm 0.003$. The other has the z axis at 7 ± 1° to the c axis and $g_x = 4.155 \pm 0.005$, $g_y = 3.704 \pm 0.005$, $g_z = 1.155 \pm 0.003$. The spectra arise from Yb^{3+} ions at Ca^{2+} sites and the rhombic symmetry is caused by charge compensation at next-nearest-neighbor Ca^{2+} sites. The possibility of W^{6+} substitution is discussed. (auth)

23526 PARAMAGNETIC RESONANCE AND RELAXATION OF TRIVALENT RARE-EARTH IONS IN CALCIUM FLUORIDE. I. RESONANCE SPECTRA AND CRYSTAL FIELDS. M. J. Weber and R. W. Bierig (Raytheon Corp., Waltham, Mass.). Phys. Rev., 134: A1492-1503(June 15, 1964).

The energy level structures arising from the crystal-field splitting of the free-ion ground states of trivalent rare-earth ions in CaF_2 are determined from a survey of the optical and electron paramagnetic resonance spectra. The predicted ground states are in agreement with existing paramagnetic resonance data. Estimates are made of the magnitude of the cubic crystal-field parameters and their variation throughout the rare-earth series. Axial crystal fields of tetragonal and trigonal symmetries, due to nearest-neighbor charge compensation, are found to cause large perturbations on the cubic-field energy levels. The paramagnetic resonance spectra of all rare-earth ions are reviewed and new resonances for Ce^{3+}, Sm^{3+}, Er^{3+}, and Yb^{3+} are reported. Expressions for the calculation of crystal-field matrix elements in terms of 3-j and 6-j symbols and their relation to the operator equivalent approach are given. (auth)

23527 PARAMAGNETIC RESONANCE AND RELAXATION OF TRIVALENT RARE-EARTH IONS IN CALCIUM FLUORIDE. II. SPIN-LATTICE RELAXATION. R. W. Bierig, M. J. Weber, and S. I. Warshaw (Raytheon Corp., Waltham, Mass.). Phys. Rev., 134: A1504-16(June 15, 1964).

The temperature dependence of the spin-lattice relaxation time T_1 of trivalent rare-earth impurities in CaF_2 was measured at 9.6 kMc using pulse saturation techniques. The rare earths investigated include Kramers ions (Ce^{3+}, Nd^{3+}, Dy^{3+}, Er^{3+}, Yb^{3+}), one non-Kramers ion (Tb^{3+}), and one S-state ion (Gd^{3+}). The relaxation of ions in lattice sites of cubic, tetragonal, and trigonal crystal-field symmetries were studied and are found to be different. At liquid-helium temperatures the relaxation usually exhibits a T^{-1} temperature dependence; however, the magnitudes are approximately two orders-of-magnitude shorter than estimated single-phonon relaxation times based upon the orbit-lattice interaction. Measurements of the Ce^{3+} relaxation in five samples containing from 0.08 to 1.6% Ce combined with results from other ions show that T_1 decreases with increasing rare-earth concentration. Multiple exponential recoveries from saturation are observed at low temperatures and are discussed with respect to possible cross-relaxation within inhomogeneous spin systems and to other faster relaxing systems. At higher temperatures examples of both Raman and Orbach two-phonon relaxation processes are found. Calculations of two-phonon relaxation times using estimated values of the dynamic crystal fields, energy level structures, and ion wave functions yield coarse order-of-magnitude agreement with experimental values. (auth)

23528 SPIN-LATTICE RELAXATION IN RARE EARTH ETHYLSULPHATES. [PART] II. J. Van den Broek and L. C. Van der Marel (Kamerlingh Onnes Laboratorium, Leiden). Physica, 30: 565-87(Mar. 1964).

The results of Hartshorn bridge measurements at low temperatures on dysprosium and ytterbium ethylsulfate are presented and discussed. The g-values, Curie-Weiss temperatures, and magnetic specific heat constants are in good agreement with literature values. The perpendicular susceptibility of DyES is shown to be largely due to second order Zeeman effect; its theoretical value, calculated from the Powell and Orbach wave functions, agrees within 7% with the experiments. The spin-lattice relaxation times in DyES are in good agreement with those from other authors and, above 1.7°K, with Orbach's theory for the two-phonon resonance process. There are indications of the two-phonon process through the second excited Kramers doublet at k × 29.1°K above the ground state. Below 1.7°K deviations from the theory of the direct process occur, similar to the deviations found in many salts of the iron group. In ytterbium ethylsulfate the temperature dependence of the inverse relaxation time may be described by a sum of T, T^9 and exp − 59/T or exp − 46/T terms. The values of τ estimated from Orbach's theory are, however, more than a thousand times larger than those experimentally found. In both salts the magnetic field dependence of the relaxation times agrees well with the Brons-Van Vleck formula in the two-phonon region. Significant deviations from the theory of Casimir and Du Pré are found only in the DyES single crystal (c-axis direction), above the lambda point of liquid helium. The agreement with Einstein's theory is rather poor, but the estimated values of the lattice heat conductivity agree with values previously found in other crystals. With the same heat conductivity, it is possible to explain why no deviations are found in the ytterbium ethylsulfate single crystal. (auth)

23529 STATE DIAGRAM OF THE SYSTEM Sc_2O_3-MgO. S. G. Tresvyatskii, L. M. Lopato, and Z. A. Yaremenko (Inst. of Problems in Studies of Materials, Academy of Sciences, Ukrainian SSR). Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 1, 29-33(Jan.-Feb. 1964). (In Russian)

The state diagram of Sc_2O_3-MgO was investigated by the method of annealing and hardening. It was found to be eutectic with limited solubility in the solid state. (auth)

23530 NITROGEN-15 MAGNETIC RESONANCE SPECTROSCOPY. I. CHEMICAL SHIFTS. Joseph B. Lambert, Gerhard Binsch, and John D. Roberts (California Inst. of Tech., Pasadena). Proc. Natl. Acad. Sci. U. S., 51: 735-7 (May 1964).

Resonance signals from ^{15}N were obtained from a series of ^{15}N-enriched compounds with a spectrometer operating at 6.08 Mc and 14,100 gauss. Chemical shifts were measured by the sideband technique and are reported with respect to anhydrous ammonia. (C.E.S.)

23531 ROTATIONAL ANALYSIS OF SOME SINGLET TRANSITIONS IN THE SPECTRUM OF GASEOUS SCANDIUM MONOFLUORIDE. R. F. Barrow, W. J. M. Gissane, R. C. Le Bargy, G. V. M. Rose, and P. A. Ross (Oxford Univ.). Proc. Phys. Soc. (London), 83: 889-90(May 1964).

A number of band systems attributed to ScF were observed both in absorption and in thermal emission at high temperatures (~2000°C). Rotational analyses were made of bands of four singlet systems. These systems all appear in absorption, and the lower state $X\ ^1\Sigma$ is probably the lowest singlet state of ScF. Bands of more complex appearance, perhaps arising from triplet transitions, are also observed in absorption, so that the nature of the ground state is not yet established. The value of the internuclear distance r_0 in $X\ ^1\Sigma$ is 1.791 Å. (auth)

23532 THERMAL IONIZATION AND ELECTRONEGATIVE SPECIES. A. E. Fuhs (Aerospace Corp., El Segundo, Calif.). Pyrodynamics, 1: 3-25(Jan.-Feb. 1964).

Free electrons that are present in the ionized gas of the re-entry plasma sheath or the exhaust of rockets cause severe attenuation and reflection of electromagnetic waves. Conditions that are favorable or unfavorable for "soaking up" electrons were examined. The work of Sanochkin was extended to include thermal ionization in a gas mixture with electronegative species. General formulas were specialized for the reactions: $A \rightleftharpoons A^+ + e^-$; $B^- \rightleftharpoons B + e^-$; $C \rightleftharpoons C^+ + e^-$. A model gas was used where each species was characterized by its ionization potential or its electron affinity. The degree of ionization (the ratio of electron to particle density), the fraction of A, B, or C ionized, and the ratio of electron density with and without additives were calculated as a function of kT with pressure and mole fraction of additives as parameters. The notation (I_A, I_B, I_C) was used to identify a mixture, where I_A is the ionization potential in electron volts of species A, etc.: calculations were performed for $(4, 4, \infty)$, $(16, 4, \infty)$, $(16, 4, 4)$, $(4, 2, \infty)$, $(16, 2, 4)$, and $(16, 4, 2)$ mixtures. When ionization potential and electron affinity are equal, electrons are absorbed efficiently up to kT of about I/10. When ionization potential exceeds electron affinity, the efficiency for free electron removal decreases markedly. If $I_A \leq I_B$, calculations show that a mixture of equal parts of A and B would be an all-ion (nearly) plasma at low energy. An experiment was conducted in which the conductivity of an argon plasma jet and the conductivity of an argon-with-SF_6 plasma jet were measured. The results of the experiments were consistent with the calculations. (auth)

23533 THE INFLUENCE OF MELT NATURE ON FORMATION OF ANOMALOUS MIXED CRYSTALS CaF_2-CeF_3 AND CaF_2-YF_3. K. G. Myakishev and V. R. Klokman. Radiokhimiya, 5: 649-55(1963). (In Russian)

Distribution of cerium and yttrium fluorides between the melt and CaF_2 crystals in the CaF_2-LiF and CaF_2-CaCl_2 systems was studied. In contrast to purely fluoride systems of CaF_2-NaF and CaF_2-LiF, the distribution of cerium and yttrium fluorides in CaF_2-CaCl_2 follows Khlopin's law. The gaseous media does not influence the distribution of CeF_3 and YF_3 and the increase of CeF_3 and and YF_3 crystallization in the CaF_2-CaCl_2 system with drop in temperature was interpreted as the result of reduced activity of macrocomponent ions at the expense of lowered dissociation of the complex compound, $CaF_2 \cdot CaCl_2$. (R.V.J.)

23534 COMPLEXING OF U(IV) WITH HALIDE, SULFATE, AND PERCHLORATE ANIONS BY PROTON RESONANCE METHOD. V. M. Vdovenko, G. A. Romanov, and V. A. Shcherbakov. Radiokhimiya, 5: 664-8(1963). (In Russian)

The complexing of U(IV) with Cl^-, Br^-, I^-, and SO_4^{2-} ions in $2\underline{N}$ $HClO_4$ was studied using the proton resonance method. The complexing of U(IV) with the respective anions resulted in the disintegration of the perchlorate complex. Stability constants were developed for the UC^{3+}, UBr^{3+}, UI^{3+}, $U(SO_4)^{2+}$, and $UClO_4^{3+}$ complexes. The effective magnetic moment, μ_N, was found for the hydrated U(IV) ion. (R.V.J.)

23535 INFRARED SPECTRA AND STRUCTURE OF URANYL NITRATE COMPLEX WITH CESIUM AND PYRIDINE NITRATES. A. A. Lipkovskii and M. G. Kuzina. Radiokhimiya, 5: 668-74(1963). (In Russian)

Infrared absorption spectra of tetranitrate compounds of uranyl nitrate with cesium nitrate and pyridine were studied in order to determine the metal-nitrate bond in these compounds. It was found that according to the infrared absorption spectra the nitrate groups are heterodynamic. It is suggested that they represent binary salts of the $MUO_2(NO_3)_3 \cdot MNO_3$ type where M can be organic or an inorganic cation. (R.V.J.)

23536 SOLUBILITY OF GYPSUM IN AQUEOUS SOLUTIONS OF LANTHANUM, PRASEODYMIUM, NEODYMIUM, AND SAMARIUM CHLORIDES AT 25°C. Z. I. Grigorovich and O. Ya. Samoilov. Radiokhimiya, 5: 686-90(1963). (In Russian)

The solubility of gypsum in aqueous solutions of La, Pr, Nd, and Sm chlorides at 25° and rare earth concentration to 2.5 molal was determined. The solubility values obtained were used for describing the cation hydration of the cations investigated and for finding the bond between the cations and the nearest water molecules. An increased (from La to Sm) covalence interaction between the cations and the nearest water molecules resulted in a weakened OH bond in the water molecules distributed near the rare earth cations. (R.V.J.)

23537 PREPARATION OF Th, U, AND Pu OXIDE AND RARE EARTH COATINGS BY ELECTROLYTIC PRECIPITATION FROM ORGANIC SOLUTIONS. B. A. Gvozdev and Yu. T. Chuburkov. Radiokhimiya, 5: 712-15(1963). (In Russian)

The preparation of lanthanide and actinide oxide coatings by electrolytic deposition from organic media is described. Cyclotron targets with multicharged ions were prepared by deposition of Th, U, Pu, La, Pr, Nd, Gd, Pb, Ca, In, and Fe oxides on thin (5-μ) 5 cm² aluminum foils. (R.V.J.)

23538 SYNTHESIS OF PLUTONYL CARBONATES. V. D. Nikol'skii and A. A. Fedulova. Radiokhimiya, 5: 744-7(1963). (In Russian)

Series of plutonyl carbonates were synthesized by hydrolysis and additions of alcohol and barium. Pentacarbonatediplutonyl ammonium was prepared after 36 hr reaction of plutonyl nitrate with 2.5M ammonium carbonate. Pentacarbonatediplutonyl ammonium is a crystalline dark green powder which dissolved in water without forming any sediment. A barium derivative of pentacarbonatediplutonyl was synthesized at pH = 8.79, 8.76, and 8.67 by adding stoichiometric amounts of barium chloride. Barium bicarbonate $Ba[PuO_2(CO_3)_2](H_2O)$ was prepared at pH = 8.52, 8.55, and 8.47. Prepared plutonyl barium carbonates $Ba_3[(PuO_2)_2(CO_3)_5(H_2O)_{10}]$, $Ba[PuO_2(CO_3)_2(H_2O)_3]$, and $Ba_3[(PuO_2)_2(CO_3)_3(OH)(H_2O)_{5.5}]_2$ with endothermal effect below 100° and $Ba[PuO_2(CO_3(OH)(H_2O)_3]_2$ at 117° were analyzed. Tricarbonatedplutonyl ammonia and pentacarbonatediplutonyl crystallized without water. (R.V.J.)

23539 STUDY OF THE COPRECIPITATION OF CERIUM WITH POTASSIUM SULFATE. III. INTERACTION OF CERIUM WITH THE SURFACE OF THE POTASSIUM SULFATE CRYSTALS. I. V. Melikhov and E. K. Kirkova. Radiokhimiya, 6: 5-11(1964). (In Russian)

The reaction kinetics and the isotherms of the primary and secondary adsorption of microamounts of Ce on the surface of K_2SO_4 crystals in a saturated aqueous solution of the macrocomponent were investigated by preparing the crystals by repeated recrystallization of the finely divided precipitate. The stable Ce precipitate was used in the form of a suspension. Entrapment of the admixture by the surface of the stable deposit occurs under conditions of diffusion, under kinetic or intermediate conditions, depending on whether the rate of capture of the admixture is controlled by the diffusion of the material from the bulk to the phase boundary, its interaction with the surface, or by both. It was found that the kinetic conditions prevail in the process of the entrapment of microamounts of Ce by the surface of the stabilized K_2SO_4 crystals. The transition of the Ce from the solution to the crystal surface, the kinetics of the desorption of the admixture from the surface, and the adsorption isotherm indicated that both the adsorption and the removal of the admixture from the surface of the solid phase represent a first-order process. (TTT)

23540 STUDY OF THE COMPLEX FORMATION IN MELT BY MEANS OF ISOMORPHOUS RECRYSTALLIZATION IN THE $PbCl_2-SrCl_2-RbCl$ AND $PbCl_2-SrCl_2-CsCl$ SYSTEMS. V. R. Klokman and N. S. Kolesnikova. Radiokhimiya, 6: 11-18(1964). (In Russian)

Following up previous studies on the coprecipitation of ^{90}Sr with $PbCl_2$ from molten systems with a simple eutectic (Radiokhimiya, 5: 284(1963) No. 3), the behavior of ^{90}Sr was examined in systems in which complex compounds are formed. The states of the macro and microcomponents in the liquid phase were estimated on the basis of the transition from eutectic systems to systems containing chemical compounds by determining the crystallization coefficient D of the $SrCl_2$ by its distribution between the $PbCl_2$ crystals and the melt. The D values in the $PbCl_2$–RbCl and $PbCl_2$–CsCl systems were much higher than in the melts formed by $PbCl_2$ and LiCl, NaCl or KCl. This was due to the increasing stability of the complex compounds of the macrocomponent with increasing ionic radius of the alkali metal used. Under the experimental conditions used the $PbCl_2$–alkali chloride compounds were found to be more stable than the corresponding Sr compounds. The presence of complex compounds in the melt may be demonstrated not only in the crystallization range of the complex but also in the area in which the pure compound is precipitated out. (TTT)

23541 THE KINETICS OF THE OXIDATION OF TETRAVALENT URANIUM IN PERCHLORIC ACID SOLUTIONS BY POTASSIUM CHLORATE. L. A. Fedorova. Radiokhimiya, 6: 42-9(1964). (In Russian)

Study of the oxidation mechanism of $HClO_4$ solutions of U(IV) by $KClO_3$ is of interest for clarification of oxidation–reduction processes involving this ion, because in this medium no U(VI) and U(IV) complexes are formed by oxidation. The reaction rate was determined on the basis of spectrophotometric measurements of the U(IV) concentration. The U(VI) perchlorates were prepared by dissolving spectroscopically pure UO_3 in $HClO_4$; these solutions yielded U(VI) perchlorates by electrolytic reduction. The reaction constants were found to vary, depending greatly on the experimental conditions used. The general order of the reaction was between 1.5 and 2.6. The bimolecular character of the reaction and the slight salting effect indicated that unchanged $HClO_4$ molecules participate in the reaction. Addition of salt increased the reaction rate by the catalytic effect of the H ions. The rate of the oxidation reaction may be expressed by the following equation: $w = K[U(IV)][ClO_3^-][H^+] = K_3 \cdot K_d[U(IV)][HClO_3]$. At $[H^+]$ concentrations from 0.1 to 0.75N the rate constant of the bimolecular reaction was found to be K = 10.6 lit. mol^{-1} hr^{-1}. (TTT)

23542 PROCESSES AND REACTION PRODUCTS OF HIGH-MOLECULAR-WEIGHT COMPOUNDS WITH INORGANIC SALTS. III. REACTIONS OF AQUEOUS POLYACROLEIN SOLUTIONS. I. V. Andreeva, P. F. Andreev, L. T. Danilov, and E. M. Rogozina. Radiokhimiya, 6: 86-93(1964). (In Russian)

Polymers having an aldehyde group in their structures can take up various metals from aqueous solution. The hydrated form of the aldehyde can split off water with a change in external conditions and can give characteristic aldehydic reactions. A 3% mineral salt solution was added to an equal volume of a 3% polyacrolein solution at various solution pH's. The mixture was heated to 90 to 98°C on a water bath. Preliminary experiments showed that elements of the 1st and 2nd group, Co, Ni, Cu, Sc, Fe(III), Fe(II), Mn(II), La, UO_2^{2+}, and Ag do not give visible precipitates at a pH of 1 to 5. Th, Zr, and Ti formed precipitates in the cold at a pH <5. The % Th precipitated increased rapidly with increasing pH, and became 100% at a pH = 3.75. Analysis of the Th precipitate showed that it contained 24 to 28 molecules of the $C_6H_{10}O_3$ group per Th atom on precipitation from an acid solution, and 8 to 9 molecules of the $C_6H_{10}O_3$ group on precipitation at a pH of 4.7 to 8.3. Uranium could be quantitatively precipitated at a pH of 4 on adding NaCl or K_2SO_4 to the solution as a salting agent. The behavior of Th was also similar in this respect. Copper was precipitated when added as an ammoniacal complex to a polyacrolein solution. Reactions in solutions of polyvinyl alcohol were similar to reactions in polyacrolein solutions, when dehydrating conditions were not employed. (TTT)

23543 THE THORIUM ACETATES. I. Geletseanu, A. V. Lapitskii, M. Veiner, M. A. Salimov, and E. P. Artamonova. Radiokhimiya, 6: 93-101(1964). (In Russian)

On mixing equal volumes of 1 to 2M sodium acetate with 0.1M $Th(NO_3)_4$ at a pH = 4.5 to 5, and then adding methyl alcohol in an amount >½ of the total volume, it was found that the basic thorium salt $Th(OH)_2(CH_3COO)_2 \cdot 2H_2O$ is formed. Tracer experiments with ^{234}Th showed that 80 to

90% of the thorium precipitates under these conditions. Various thorium trichloracetates compounds were obtained by mixing 5$\underline{M}$ CCl_3COOH with 0.2$\underline{M}$ $Th(NO_3)_4$ in the cold without adding methyl alcohol. Thus, $Th(CCl_3COO)_4 \cdot 2H_2O$ was obtained at a pH = 0.8 to 1, $Th(OH)(CCl_3COO)_3 \cdot 2H_2O$ at a pH = 2.8, and $Th(OH)_2(CCl_3COO)_2 \cdot 2H_2O$ at a pH = 3.8. Thorium became hydrolyzed at higher pH values. The presence or absence of the OH group in the compound was determined by infrared spectroscopy. Determination of the molecular weight by the decrease in freezing point showed that the thorium compound is present in the form of a dimer in 0.05$\underline{M}$ thorium acetate solutions. Association takes place by hydrogen bonding between a hydroxyl group of hydrolyzed thorium, and a carboxyl group from the carboxylic group of another thorium molecule. X-ray analysis showed that $Th(OH)_2(CH_3COO)_2 \cdot 2H_2O$ is amorphous, and that $Th(OH)(CCl_3COO)_3 \cdot 2H_2O$ is crystalline. The results of nuclear magnetic resonance measurements also showed the presence of hydrogen bonding in $Th(OH)_2(CH_3COO)_2 \cdot 2H_2O$, and of oxygen bridges in $Th(CCl_3COO)_4 \cdot 2H_2O$. The solubility of thorium acetate was 0.05$\underline{M}$, and the solubility of thorium trichloracetate was 0.018 g per 100 g water. (TTT)

23544 THE STOICHIOMETRY OF THE COMPOUND FORMED BY URANYL NITRATE AND TRIOCTYL AMINE NITRATE. V. M. Vdovenko, M. G. Kuzina, and A. A. Lipovskii. Radiokhimiya, 6: 121-3(1964). (In Russian)

It was noted previously that passage of uranyl nitrate into the organic phase does not follow the expected stoichiometric ratio. An attempt was therefore made to determine the composition of the complex thus formed by the saturation method, using $UO_2(NO_3)_2$ and its hexahydrate as the solid phases. They were brought in equilibrium with trioctylamine nitrate ($TOA \cdot HNO_3$) in the organic solvent and the system was analyzed for U, TOA, and H_2O after equilibrium was reached. It was found that an increase of the water concentration in the system leads to an increase of the TOA : U ratio, which is further increased if the extraction is carried out from concentrated aqueous solutions of U. The electron absorption spectra of the solutions with a TOA : U ratio equal to 2 agree with that of the compound $TOA \cdot HUO_2(NO_3)_3$. Water in the organic phase may casue the formation of H bonds with the O atoms of the nitrate groups, leading to the creation of associated compounds, and may also be responsible for the decreased solubility of $UO_2(NO_3)_2 \cdot 6H_2O$ as compared to the dihydrate. Vibration spectra were used for determining the structure of the compounds; they indicated that no uranyl tetranitrate complex was formed in the system. (TTT)

23545 DETERMINATION OF THE SOLUBILITY OF THE PRECIPITATED URANYL PHOSPHATES OF THE ALKALI METALS BY MEANS OF LABELED ATOMS. I. A. Murav'eva, K. B. Zaborenko, O. G. Nemkova, and Hang-tieh Ping. Radiokhimiya, 6: 124-7(1964). (In Russian)

The method developed by A. K. Babko (Naukovi Zapiski KDU, khim. zbirnik, 1: 155(1956)) was used for determining the solubility of the double phosphates of uranyl and Li, Na, K, and Rb. Conductometric, potentiometric, and chemical methods were used for determining the composition of the double salts; the P content of the system was measured using ^{32}P as the indicator and determining its activity with the help of a halide counter. The precipitated salts were carefully separated from the supernatant liquid by centrifugation. The following values were obtained for the solubility product of the various salts: $LiUO_2PO_4$, 2.4×10^{-26}; $NaUO_2PO_4$, 6.4×10^{-25}; KUO_2PO_4, 8×10^{-24}; and $RbUO_2PO_4$, 1×10^{-27}. In order to take the effect of hydrolysis into consideration, the pH of the saturated solutions was varied and the PO_4^{3+} ion concentration was calculated from the dissociation constant of H_3PO_4 at 25°C. (TTT)

23546 ON THE THERMAL EXPANSION OF OXYGEN-18 WATER. Chen-nan Ku and Tsing-lien Chang (Peking Univ.). Sci. Sinica (Peking), 13: 688-9(Apr. 1964).

The thermal expansion of oxygen-18 water with natural hydrogen isotopic composition was measured by direct pyrometry at 5 to 90°C. Specific gravities and densities are given. (R.E.U.)

23547 URANIUM CONTENTS OF ANCIENT MAN-MADE GLASS. R. L. Fleischer and P. B. Price (General Electric Research Lab., Schenectady, N. Y.). Science, 144: 841-2(May 15, 1964).

The concentrations of U impurities in a variety of ancient man-made glasses were determined by counting the sites of neutron-induced fissions. There appears to be a chronological trend from low to high and back to low U contents over the past three millennia. Crude estimates of ages by fission-track counting should be possible with considerable labor for the group of glasses which was found to have the highest concentration of U. (auth)

23548 SORPTION AND FIXATION OF MICROQUANTITIES OF CESIUM BY CLAY MINERALS: EFFECT OF SATURATING CATIONS. B. L. Sawhney (Connecticut Agricultural Experiment Station, New Haven). Soil Sci. Soc. Am. Proc., 28: 183-6(Mar.-Apr. 1964).

Sorption and fixation of microquantities of Cs by six minerals, as affected by the saturating cations, were studied. Micas and vermiculite sorbed more Cs in the presence of Ca and similar divalent cations than in the presence of K and similar monovalent cations. Montmorillonite and kaolinite, on the other hand, sorbed more Cs in the presence of K than in the presence of Ca. While micas and vermiculite fixed large proportion of the Cs sorbed, montmorillonite and kaolinite did not fix significant amounts of Cs against replacement by neutral salts. Thus, whereas Cs sorption by montmorillonite and kaolinite appeared to be largely electrostatic, the sorption and fixation of Cs by micas and vermiculite was governed by the size and hydration, rather than valence, of the competing cation. Micas particularly exhibited a large fixation of Cs. It is suggested that the fixation of Cs by micas occurs at the crystal edges where Cs may replace K and thus become a part of the stable mica structure. (auth)

23549 INFRARED ABSORPTION STUDY OF METAL OXIDES IN THE LOW FREQUENCY REGION (700-240 cm^{-1}). Neil T. McDevitt and William L. Baun (Air Force Materials Lab. Research and Tech. Div., Wright-Patterson AFB, Ohio). Spectrochim. Acta, 20: 799-808(May 1964).

The characteristic frequencies of oxides of 52 metals were studied in the region 700-240 cm^{-1}. Data for oxides of metals of different valence states and the frequencies of polymorphic forms of several oxides are presented. A particle size of 10 μ or smaller was found to give the best representative spectrum. (auth)

23550 COMPARISON OF THE MECHANISMS OF HYPERSENSITIZATION OF IONOGRAPHIC EMULSIONS BY CRITICAL FERROUS-FERRIC SULFATE AND T.E.A. R. Schmitt, M. Debeauvais-Wack, H. Braun, R. Demoulin, and P. Cueer (Departement de Physique Corpusculaire, Strasbourg). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 244-9(1963). (In French)

Experiments are performed that indicate that triethanolamine plays an essential role in the formation of the latent image, and that this role is not that of a Br acceptor. A method of development at low temperature followed by reheating in a sensitizing solution is used; this method has the advantage of removing several unknown factors from the sensitization. (T.F.H.)

23551 SOME IDEAS ON THE HYPERSENSITIZATION OF LAYERS OF EMULSION FOR NUCLEAR STUDIES. T. I. Krestovnikova and V. M. Ouvarova (NIKFI Inst., Moscow). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 250-7(1963). (In French)

The mechanisms for sensitization of nuclear emulsion (NIKFI-R) by triethanolamine or inorganic bases are investigated. The effects of addition of glycerine to the sensitizing solutions are studied. Prolonged exposure of the emulsions to KBr solutions is found to completely destroy the hypersensitization. (T.F.H.)

23552 ON THE MECHANISM OF SENSITIZATION OF PHOTOGRAPHIC EMULSION BY T.E.A. M. Nicolae and V. Labau (Inst. of Atomic Physics, Bucharest). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 258-72(1963). (In French)

Experiments are reported that show: that the mechanisms of action of triethanolamine (TEA) and alkaline solutions are different; that it is the reducing capacity of TEA that is brought into play; that the solubilities of Ag halides in TEA increase rapidly with the concentration; and that the only effect that pH has on the sensitizing properties of TEA is the effect that pH has on TEA's redox potential. (T.F.H.)

23553 PENETRATION OF URANIUM INTO EMULSIONS. INFLUENCE OF URANIUM ACETATE ON THE PHOTOGRAPHIC MECHANISM. A. Burdet (Institut de Physique Nucléaire, Lyon). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 283-5(1963). (In French)

Experimental results on the impregnation of photographic emulsions by U salts are given. This impregnation depends critically on the salt used and the pH of the solution. The emulsions employed are K2 and K5. (T.F.H.)

23554 PROTECTIVE EFFECTS OF SODIUM SULFITE ON DILUTED AMIDOL DEVELOPER. H. G. Carvalho, M. Muchnik, G. Potenza, and R. Rinzivillo (Università, Naples and Instituto Nazionale de Fisica Nucleare, Naples). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 333-5(1963).

Ordinary photographic film is developed in dilute amidol developer baths containing varying concentrations of sodium sulfite. The time of development is used as an index of developer activity. It is found that even high sulfite concentrations are insufficient to prevent amidol oxidation by the ambient air. The effects of storage time upon the results are studied. A solution to the problem is suggested, viz. developing in a N_2 atmosphere. (T.F.H.)

23555 CONTINUOUS SWELLING MEASUREMENTS IN THE DEVELOPMENT OF NUCLEAR TRACK EMULSIONS. H. Frieser, G. Heimann, and H. Eger (Institut für Wissenschaftliche Photographie, Munich). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 339-45 (1963). (In German)

A process for preparing nuclear emulsions by control of layer thickness changes resulting in a constant degree of swelling is described. An apparatus developed for continuous measurement of the thickness of the disks is also described. A strong swelling occurred in the stopbath (0.5 to 3% acetic acid). Replacement of the acetic acid with potassium bromide reduced the amount of swelling. (M.C.G.)

23556 DISTORTION OF PLATES SWOLLEN WITH COLOPHONY ROSIN. J. Casanova, J. Catala, and E. Villar (Facultad de Ciencias, Santiago de Compostela, Spain and Facultad de Ciencias, Valencia, Spain). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 399-401 (1963).

It is found that Ilford K-5 emulsion plates swollen with Colophony Rosin undergo much less distortion than unswollen plates of the same dimensions during development. It is also found that the distortion of the swollen plates is more uniform than that of the unswollen plates. (T.F.H.)

23557 INVESTIGATIONS ON THE ELECTROLYTIC URANIUM DEPOSITION ON METALS. [PART] I. V. Pfeifer (Österreichische Studiengesellschaft für Atomenergie GmbH, Vienna). Mikrochim. Ichnoanal. Acta, No. 1, 49-54 (1964). (In German)

The preparation of thin layers of uranium oxide by electrolysis by means of sodium fluoride as electrolyte is described. The studies dealt with finding the optimal electrolyte concentration, on which the length of the electrolysis is greatly dependent; they also show the effect of the volume and of the amount of uranium itself on the deposition. Layer thicknesses corresponding to 400 μg U/cm^2 were produced. The apparatus described permitted the production of preparations up to 6 cm^2. (auth)

23558 FAR INFRA-RED SPECTRA OF MOLECULAR CRYSTALS. I. HYDROGEN AND DEUTERIUM HALIDES. A. Anderson (National Physical Lab., Teddington, Middx, Eng.), H. A. Gebbie, and S. H. Walmsley. Mol. Phys., 7: 401-9(1963-64).

Absorption spectra of crystalline films of hydrogen and deuterium chloride and bromide at 77°K were measured in the region 20–400 cm^{-1} using a Michelson interferometer. The absorptions are assigned as lattice vibrations, and translational and torsional modes are distinguished. It is shown that the observed spectra are consistent with a crystalline structure of four molecules per unit cell in a planar array and approximate values of the principal intermolecular force constants are derived. (auth)

23559 PROTON RELAXATION TIMES IN ALKALI HALIDE SOLUTIONS. B. P. Fabricand, S. S. Goldberg, R. Leifer, and S. G. Ungar (Columbia Univ., New York). Mol. Phys., 7: 425-32(1963-64).

Measurements of the proton spin-lattice relaxation times as a function of concentration in aqueous alkali halide solutions are used to investigate the interactions between the ions and water molecules. A simplified model of a solution is used in which local proton relaxation times are assigned to three different sites: those near the anion, those near the cation and those not near any ion. A procedure is worked out to calculate the local relaxation times and the number of nearest-neighbor water molecules using the data and the B-viscosity-coefficients of the solutions. Differences in the activation energies for a change in configuration about an ion relative to pure water are obtained. These indicate that the configurations of water molecules around the Li, Na, and F ions are more stable than in pure water, while those configurations about all other ions are less stable. Furthermore, the degree of stability decreases with increasing ionic radius. (auth)

23560 THE USE OF THE ISOTOPIC SEPARATION FACTOR BETWEEN LIQUID AND VAPOUR FOR THE STUDY OF INTERMOLECULAR POTENTIAL AND VIRIAL FUNCTIONS. J. S. Rowlinson (Imperial Coll. of Science and Tech., London). Mol. Phys., 7: 477-80(1963-64).

It is shown that the isotopic separation factor, α, for a monatomic liquid in equilibrium with its vapor at low temperatures can be used to calculate the mean-square fluctuations of the intermolecular virial function. The only knowledge of the intermolecular energy that is required is the separation, σ, at which the pair potential is zero. If the additional assumption is made that this potential is of the Lennard-Jones (n, m) type, then it is possible to relate α to n, m, σ and the thermodynamic properties of the fluid phases. Hence, recent experimental values of α for argon can be used to test potentials of the Lennard-Jones type without any assumption about the structure of the liquid. (auth)

23561 MEASUREMENT OF THE ^{73}Ge-PROTON SPIN-SPIN COUPLING IN $Ge(CH_3)_4$. A. Tzalmona (Varian AG, Zurich). Mol. Phys., 7: 497-8(1963-64).

The splitting of the methyl proton magnetic resonance line in pure liquid $Ge(CH_3)_4$ was measured with a high-resolution spectrometer. The ^{73}Ge-proton spin-spin coupling was determined to be J = 2.94 cps; $J_{13_{CH_3}}$ was found to be 124.5 cps. (D.C.W.)

23562 RATE-DEPENDENT CRYSTALLIZATION IN BERYLLIUM-CONTAINING MELTS. R. P. Miller and R. A. Mercer (National Chemical Lab., Teddington, Middx., Eng.). Nature, 202: 581-3(May 9, 1964).

It is shown that the crystallization ordering processes in beryllium-containing melts are dependent upon the cooling rate. (C.E.S.)

23563 ELECTRON MICROSCOPY OF BETA-BERYLLIA. A. H. Willis, S. B. Austerman, and K. Dearborn (Atomics International, Canoga Park, Calif.). Nature, 202: 689(May 16, 1964).

The formation of β-beryllia was observed in the electron microscope. Transformation to the high-temperature form was accomplished by defocusing the illuminating electron beam and allowing a more intense beam to strike the beryllia sample. It is proposed that the β-beryllia was not derived directly from the crystal, but that it is a condensate resulting from partial evaporation of the crystal under the defocused beam. (C.E.S.)

23564 TRITIUM LABELING OF ARTEMISIA KETONES WITH HIGH SPECIFIC ACTIVITY. Paul-Eberhard Schulze and Wolfram Dornfeldt (Technische Universität, Berlin). Naturwissenschaften, 51: 58(1964). (In German)

Artemisia ketones were labeled with tritium in order to follow its still largely unknown fate in the plant organism. For labeling, 100 mg of Artemisia ketone was dissolved in 3.6 ml dioxane and mixed with 5 drops concentrated H_2SO_4 and 1 ml HTO (about 1C) and held for 60 hr at 70°C. Fifty-eight grams of pure material with a specific activity of 250 μC/mg was obtained. The purity was controlled by multiple recrystallization. (M.C.G.)

23565 ELECTRON MICROSCOPE STUDIES OF URANIUM DICARBIDE PRECIPITATES IN URANIUM CARBIDE SINGLE CRYSTALS. B. L. Eyre and M. J. Sole (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phil. Mag. (8), 9: 545-56(Apr. 1964). (AERE-R-4476)

A method for preparing thin films of UC single crystals containing UC_2 precipitates is described. The films were examined by transmission electron microscopy, and the crystallographic relations between the UC_2 and the UC matrix were established using selected area diffraction techniques. Twinning is observed in the UC_2 precipitates; this is attributed to the interactions which occur when UC_2 crystals of different orientation intersect. A mechanism is proposed for the formation of UC_2 in slightly hyperstoichiometric UC. (auth)

23566 GRAIN BOUNDARY MOBILITY AND ITS EFFECTS IN MATERIALS CONTAINING INERT GASES. M. V. Speight and G. W. Greenwood (Central Electricity Generating Board, Berkeley, Gloucester, Eng.). Phil. Mag. (8), 9: 683-9(Apr. 1964).

The conditions under which grain boundaries can be pinned by solid precipitates are established. However, precipitates in the form of inert-gas bubbles are known to move by surface diffusion of the matrix atoms which surround them, and so they may remain attached to the boundary and retard its movement. The magnitude of the retarding force is calculated, and the condition under which the boundary can become detached from the bubbles is evaluated. Detachment occurs, most readily from bubbles of a critical size and under conditions where there is a large driving force for grain boundary movement. The smallest bubbles move sufficiently rapidly to tend to remain attached to the boundary. The largest bubbles, for a given spacing, have greatest effect in impeding grain boundary mobility. Their effect is compared and contrasted with that of boundary pinning by solid precipitates. The analysis is used to interpret observations of the behavior of fission gases after grain boundary movement. (auth)

23567 THE ELASTIC CONSTANTS OF POLYCRYSTALLINE CARBONS AND GRAPHITES. B. T. Kelly (United Kingdom Atomic Energy Authority, Culcheth, Lancs, Eng.). Phil. Mag. (8), 9: 721-37(May 1964). (TRG-Report-543)

An attempt is made to produce a model for the small strain elastic constants and moduli of polycrystalline carbons and graphites in terms of the dislocations present in the crystallites constituting the material. The model is mainly based on the effects of fast neutron irradiation on the moduli of reactor graphites and carbons, but a wide variety of evidence is discussed and reviewed. Explanations are suggested for the observations. (auth)

Organic Chemistry

Refer also to abstract 24234.

23568 (CEA-R-2406) SYNTHESE DU PHENOBARBITAL ^{14}C-5. (Synthesis of Phenobarbital ^{14}C-5). Achille Benakis (Geneva. Université and France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). Mar. 1964. 12p.

The synthesis of phenobarbital marked in position 2 of the pyrimidinic ring was effected. It was necessary, in order to carry out to research into the metabolism of this product, to have a phenobarbital marked in position 5 of the pyrimidinic ring. This synthesis, making it possible to introduce ^{14}C into position 5 of the pyrimidinic ring, consists of seven stages starting from ^{14}C carboxyl benzoic acid having a specific activity of 25 mC/mm. The melting point of the final product is 172–173°C and its specific activity is 11.15 mC/mm. The overall radioactive yield of the pure product, with respect to the original benzoic acid (10 mm), is of the order of 3%. The purity of the product was controlled by paper chromatography; it is of the order of 99%. (P.C.H.)

23569 (EUR-1619.e) A COMPILATION OF THE NEWEST VALUES OF THE PHYSICAL PROPERTIES OF OM_2 FOR HEAT TRANSFER PURPOSES. G. Friz, F. Reiter, and R. Nehren (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). 1964. 18p.

Values for the physical properties of OM_2, compiled for heat transfer calculations are presented. OM_2 is an industrial mixture of terphenyl isomers, produced by PROGIL (France). (auth)

23570 (ORNL-3602) KINETICS OF THE THERMAL DECOMPOSITION OF BIPHENYL. L. B. Yeatts, Jr., D. N. Hess, H. F. McDuffie, and W. T. Rainey, Jr. (Oak Ridge National Lab., Tenn.). May 1964. Contract W-7405-eng-26. 47p.

The initial rates of thermal decomposition of pure biphenyl in the liquid phase were determined for the temperature range of 422 to 446°C. The products of pyrolysis were separated into three hydrocarbon fractions in a vacuum system and determined quantitatively by gas chromatographic procedures. The amount of biphenyl which decomposed was found by difference. If it is assumed that a first order rate law is valid, the rate at which biphenyl decomposes is given by the expression $k = 1.2 \times 10^{-12} \exp(-62{,}000/RT)hr^{-1}$. The initial rates at which the four major products are formed, per mole of biphenyl, are: (1) hydrogen: 0.58×10^{-5} moles/hr at 422°C, 1.9×10^{-5} at 438°C, and 2.7×10^{-5} at 446°C; (2) benzene: 1.1×10^{-4} moles/hr at 422°C, 3.1×10^{-4} at 438°C, and 4.8×10^{-4} at 446°C; (3) terphenyls: 0.71×10^{-4} moles/hr at 422°C, 2.0×10^{-4} at 438°C, and 2.8×10^{-4} at 446°C; and (4) quaterphenyls: 0.25×10^{-4} moles/hr at 422°C, 0.77×10^{-4} at 438°C, and 1.3×10^{-4} at 446°C. The presence of water vapor in biphenyl during pyrolysis had no noticeable effect upon the rates, whereas the presence of oxygen increased the rates by a factor of about two to four. Results obtained by increasing the surface to volume ratio as much as a factor of 1000 for Pyrex and quartz surfaces indicated that the benzene yield reached a minimum value. Iron and stainless steel surfaces increased the rate of hydrogen formation tenfold. A plausible mechanism is discussed for the uncatalyzed thermal decomposition, and suggestions are made for further work which would shed light on the detailed mechanism. (auth)

23571 (ORNL-TM-860) SYNTHESIS AND INFRARED ABSORPTION SPECTRA OF N,N′,N″-TRIMETHYLBORAZINE. H. L. Holsopple and Lucy E. Scroggie (Oak Ridge National Lab., Tenn.). May 8, 1964. Contract [W-7405-eng-26]. 7p.

The synthesis of N,N′,N″-trimethylborazine is described and its infrared spectrum compared with that obtained by other workers. The compound was prepared by the reaction of lithium borohydride and methylammonium chloride in triethyleneglycol dimethyl ether. The frequencies of the major bands were shown in liquid and vapor spectra to be essentially the same as those previously described. (auth)

23572 THE RELATIVE SIGNS OF THE NUCLEAR SPIN-COUPLING CONSTANTS IN TIGLALDEHYDE AS DETERMINED BY SELECTIVE DECOUPLING AND TRANSITORY SELECTIVE IRRADIATION (NUCLEAR MAGNETIC DOUBLE RESONANCE) TECHNIQUES. Sture Forsen (Royal Inst. of Tech., Stockholm) and Ragnar A. Hoffman. Acta Chem. Scand., 18: 249-66(1964).

By use of the selective decoupling technique and a new technique employing transitory selective irradiation (TSI) the relative signs of the nuclear spin-coupling constants were determined in tiglaldehyde (2-methyl-2-butanol). The TSI method is based upon the fact that the application of a strong r-f field can be used to produce a redistribution of the spin level populations in a nuclear spin system within a time that is short compared with the spin-lattice relaxation time T_1. These population changes will then cause intensity changes for the lines that have an energy level in common with the irradiated line(s)—and only for such lines—if the spectrum is recorded within a time that is short compared with T_1. The TSI method appears to be applicable in a variety of spin systems in which the spin-lattice relaxation times (T_1) are long compared to the inverse of the apparent line-widths (T_2^*). (P.C.H.)

23573 ISOTOPIC EXCHANGE OF HYDROGEN IN HYDROCARBONS ON RARE EARTH OXIDES. II. DEUTERIUM EXCHANGE IN CYCLOHEXANE WITH Nd, Ga, AND Al OXIDES, Ce DIOXIDE AND Nd OXIDE ON ALUMINUM OXIDE. Kh. M. Minachev, E. G. Bakh, R. V. Dmitriev, and E. A. Nasedkin (Zelinskii Inst. of Organic Chemistry, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Khim., No. 3, 421-6(1964). (In Russian)

Deuterium exchange in cyclohexane on neodymium, gadolinium, and aluminum oxides, neodymium oxide on aluminum oxide, and cerium dioxide catalysts was investigated considering the temperature, volume rate, and molar ratios. A monodeuteriated cyclohexane was the principal product of the initial transformation. The distribution of exchange products is identical for all catalysts examined (except Al_2O_3) at temperature to 480°C. (R.V.J.)

23574 CONFORMATIONAL KINETIC ISOTOPE EFFECTS IN THE RACEMIZATION OF 9,10-DIHYDRO-4,5-DIMETHYLPHENANTHRENE. Kurt Mislow, Rolf Graeve, Arnold J. Gordon, and George H. Wahl, Jr. (New York Univ., New York). J. Am. Chem. Soc., 86: 1733-41(May 5, 1964).

The synthesis of specifically deuterated, optically active derivatives of 9,10-dihydro-4,5-dimethylphenanthrene (II-d_4, II-d_6, and II-d_{10}) is described. It was demonstrated that small inverse isotope effects accompany the rates of racemization of these hydrocarbons. Since the racemizations are purely conformational changes, and since replacement of protium by deuterium atoms in the 4,5-methyl positions has an accelerating effect, it was therefore unambiguously demonstrated that in severely overcrowded transition states the deuterium atom has a smaller steric requirement than the protium atom. (auth)

23575 A CRYSTALLOGRAPHIC STUDY OF SOLID BENZENE BY NEUTRON DIFFRACTION. G. E. Bacon, N. A. Curry, and S. A. Wilson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Roy Soc. (London), Ser. A, 279; 98-110(May 12, 1964).

A study by neutron diffraction of crystals of solid benzene at −55 and −135°C is discussed. Neutron reflections in four crystal zones were examined, leading to values of the atomic coordinates and thermal parameters. Superimposed upon the random motion of the carbon and hydrogen atoms, there is an oscillatory angular motion of the molecule in its own plane for which the root-mean-square amplitudes are 7.9, 4.9, and 2.5, respectively, at the three different temperatures. At the same time there are small changes in the orientation of the molecules as the temperature is reduced, of such a kind that they pack together more easily along the Z axis, thus accounting for the enhanced thermal expansion along Z compared with X. (auth)

23576 THE HYDROGEN BOND IN ALKYL AMINE SALTS. I. INFRARED SPECTRA AND THE STRUCTURE OF TRIOCTYL AMINE NITRATE. V. M. Vdovenko, T. A. Dem'yanova, M. G. Kuzina, and A. A. Lipovskii. Radiokhimiya, 6: 49-55(1964). (In Russian)

Previous studies indicated that the amine solution extracts the HNO_3 in the organic phase; however, the nature of the bond in the alkylamine salts and the mechanism of the extraction process are not sufficiently well known. This problem was investigated by means of infrared spectroscopy for the case of trioctylamine (TOA) which is typical for this class of extracting agents. It was assumed that upon forming a salt R_3NHNO_3, the proton of the acid is completely transferred to the N, forming the cation R_3NH^+. The presence of the unstable proton in the cation of the TOA salt should lead to the formation of the N–A...A type bonds, where A designates the anion of the acid. The stability of such a bond is expected to depend on the anion charge density. The infrared spectra of TOA and its compounds with HNO_3 and DNO_3 were examined specifically to to study the N–H and N–D bonds. Analysis of $TOAHNO_3$, $TOAHNO_3 \cdot nHNO_3$ and of the corresponding D compounds indicated that in the TOA nitrate the symmetry of the nitrate is distorted. Addition of the acid molecule to the alkyl amine nitrate is also due to the formation of an H bond between the OH groups of the acid and the O atoms of the nitrate ion. (TTT)

23577 THE HYDROGEN BOND IN ALKYL AMINE SALTS. II. INFRARED SPECTRA AND THE STRUCTURE OF TRIDECYL AMINE. V. M. Vdovenko, A. A. Lipovskii, and S. A. Nikitina. Radiokhimiya, 6: 56-62(1964). (In Russian)

While studying the extraction process in solutions containing large amounts of inorganic acids, such as HNO_3, it was found that an alkyl amine salt solvatable by the molecules of the acid is formed in the organic phase. On the basis of results obtained with HNO_3 added to trioctylamine, it was expected that alkyl amine salts containing other anions would also exhibit H bonds. This question was studied by examining the infrared absorption spectra of tridecylamine (TDA) chloride and its solvents with HCl in CCl_4. The results indicated that a strong H bond is formed between the proton of the N–H group in the DTA, HCl and the Cl^- ion. Addition of the HCl molecule to the salts was found to take place as the result of the formation of a H bond with the anion of the salt. The observed changes in the infrared spectra may be explained by assuming that a linear HCl_2^- ion is formed in the system. This theory agrees with previously reported data and helps to explain the increased solubility of HCl in the solution of the amine hydrochloride in CCl_4. (TTT)

Radiation Chemistry and Radiochemistry

Refer also to abstract 24300.

23578 (LFEN-15) RADIÓLISE DA ÁGUA PURA POR PROTÕES DE 1 A 2 Mev. I. FEIXE ESTACIONÁRIO. (Radiolysis of Pure Water by 1- to 2-Mev Protons. I. Steady Beam). Rui Namorado Rosa (Portugal. Junta de Energia Nuclear. Laboratório de Física e Engenharia Nucleares, Sacavém). Mar. 20, 1964. 37p.

The experimental yields of H_2O_2 produced in pure aerated water by proton beams with energies from 1 to 2 Mev and with dose rates in the range of 10^{19} to 10^{23} ev/cm^3 · sec, were measured. Two theoretical models are proposed to describe the phenomenon and to interpret the experimental results. By comparing the theory with the experiment, conclusions were drawn concerning the radius of the distribution of transient species around the proton track in pure water, and about their mean lifetime. (auth)

23579 (NP-13825) MOLECULAR CHANGES IN POLYAMIDE AND ELASTOMERIC POLYMERS DUE TO NUCLEAR, ULTRAVIOLET AND THERMAL RADIATION. Final Report. G. Hargreaves (Naval Air Engineering Center. Aeronautical Materials Lab., Philadelphia). Dec. 15, 1963. 36p.

The molecular changes in polyamide and elastomeric polymers due to nuclear, ultraviolet, and thermal radiation were investigated. Several types of nylon fibers were exposed to gamma, ultraviolet, and thermal radiation and different atmospheric conditions. The unexposed and exposed specimens were examined by the following techniques to obtain information on physical and chemical changes in the structure of the polymer: viscosity of solutions, melting point, infrared spectra, ultraviolet absorption, and microscopy. The tensile strength was measured in some instances. Results showed that no one method gives a complete picture, but the combined results from many methods give some insight into the molecular changes taking place as a result of irradiation. Two of these changes are: the molecules break at the C–N bonds creating smaller molecules and appreciable changes in the physical state and the degree of crystallinity changes. The ultraviolet resistance of some nylons was improved by small doses of gamma irradiation. (auth)

23580 (PAN-488/XVII) ON THE FLUORESCENT LIGHT EMITTED BY AQUEOUS SOLUTION IN GAMMA RADIATION FIELD. Stanislaw Kosek and Zbigniew P. Zagórski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Dec. 1963. 7p.

The luminosity of gamma-irradiated aqueous solutions of sodium salicylate was investigated. It was found that there was some fluorescence of the salicylate excited by the uv portion of the Cherenkov radiation. The influence of this fluorescence on the measured absorption spectra may be neglected. (auth)

23581 (AEC-tr-6316(p.66-9)) RADIATION-INDUCED GRAFT POLYMERIZATION ON POLYVINYL ALCOHOL. NO. 11. GAMMA-INDUCED GRAFT POLYMERIZATION OF STYRENE ON METHANOL. Ichiro Sakurada, Norio Okada, and Eiko Kugo. (Translation)

The gamma-induced graft polymerization of styrene on dried polyvinyl alcohol skin was found to proceed smoothly and rapidly in methanol but not other organic solvents. The effects of solvent fraction and styrene-methanol ratio on the graft rate were determined. An activation energy of 7.1 kcal was obtained in the temperature range of 55 to 70°C, and the polymerization reaction velocity was found to be proportional to the 0.7 to 0.8th power of the dose rate. (D.L.C.)

23582 (AEC-tr-6316(p.70-5)) RADIATION-INDUCED GRAFT POLYMERIZATION ON POLYVINYL ALCOHOL. NO. 12. SEVERAL GRAFT POLYMERIZATIONS OF POLYVINYL ALCOHOL IN AIR. Ichiro Sakurada and Kunio Okada. (Translation)

Studies were made of the irradiation of PVA film in vacuum, air, oxygen, immersed in water or an organic solvent, and at room or elevated temperature in order to study their effects on the grafting reaction with styrene and the captured radicals. A qualitative relation between the graft rate and captured radical density was observed. (D.L.C.)

23583 (AEC-tr-6316(p.76-8)) RADIATION-INDUCED GRAFT POLYMERIZATION ON POLYVINYL ALCOHOL. NO. 13. RADIATION-INDUCED GRAFT POLYMERIZATION OF SEVERAL VINYL MONOMERS ON POLYVINYL ALCOHOL. Ichiro Sakurada and Norio Okada. (Translation)

The gamma-induced graft polymerization of eleven vinyl monomers on dry PVA in methanol was studied using simultaneous and pre-irradiation at 55°C. The monomers studied were: methyl methacrylate, ethyl methacrylate, acrylic acid, methyl acrylate, ethyl acrylate, styrene, acrylonitrile, acrylamide, vinyl acetate, 5-methyl 2-vinyl pyridine, and N-vinyl 2-pyrrolidone. The homopolymerization and graft polymerization reactions are discussed. (D.L.C.)

23584 (AEC-tr-6316(p.79-83)) RADIATION-INDUCED GRAFT POLYMERIZATION ON POLYVINYL ALCOHOL. NO. 14. GAMMA-INDUCED GRAFT POLYMERIZATION OF 2-METHYL 5-VINYL PYRIDINE ON POLYVINYL ALCOHOL AND THE GRAFT POLYMERIZATION OF STYRENE BY PRE-IRRADIATION. Ichiro Sakurada, Norio Okada, and Susumu Kitamura. (Translation)

The graft polymerization of 2-methyl 5-vinyl pyridine onto PVA fiber was found to result in improved dyeability. In the graft polymerization of styrene onto PVA fiber by heating following pre-irradiation, air was found to interfere with the polymerization. By using a redox couple of H_2O_2 and Fe^{2+} in the pre-irradiation stage, the graft polymerization could be carried out in air. (D.L.C.)

23585 (AEC-tr-6316(p.84-8)) RADIATION-INDUCED GRAFT POLYMERIZATION ON CELLULOSE. NO. 3. GAMMA-INDUCED GRAFT POLYMERIZATION OF STYRENE ON SEVERAL TYPES OF CELLULOSE. Ichiro Sakurada, Norio Okada, and Nariyuki Hatayama. (Translation)

The effects of solution composition, solvent, cellulose type, and temperature on the gamma-induced graft polymerization of styrene on cellulose in air were studied. The graft rate is optimum in methanol solvent. The cellulose types studied included ordinary rayon, super rayon, polynoshics, and cotton, and the temperature range was from 30 to 80°C. (D.L.C.)

23586 (AEC-tr-6316(p.89-94)) RADIATION-INDUCED GRAFT POLYMERIZATION ON CELLULOSE. NO. 4. GRAFT POLYMERIZATION OF STYRENE ON PRE-IRRADIATED CELLULOSE WITH VARYING FINE STRUCTURE. Ichiro Sakurada, Kunio Okada, Fujiko Kimura, and Namiko Minegawa. (Translation)

Ordinary viscose rayon staple fiber, super strong viscose rayon staple fiber, polynoshics fiber, and cotton were compared with respect to the graft reaction with styrene following pre-irradiation with a beta beam. The effects of solvents and water on the graft rate were studied. The effects of refining degree and other pre-graft treatments were also studied. The redox system of H_2O_2 and Fe^{2+} promotes the graft reaction in air. (D.L.C.)

23587 (AEC-tr-6316(p.95-9)) RADIATION-INDUCED GRAFT POLYMERIZATION ON CELLULOSE. NO. 5. RADIATION INDUCED GRAFTINGS ON SEVERAL TYPES OF CELLULOSE. Ichiro Sakurada, Norio Okada, Fujiko Kimura, and Namiko Minegawa. (Translation)

Ordinary viscose, super viscose, polynoshics, and cotton (A, B, C, and D, respectively) were pre-irradiated in air with a beta beam and then stored in different atmospheres. The graft activity is gradually lost in 65% RH air or on heating, while it is prolonged in vacuum or air at −78°C. The stability of the graft activity follows the order D > C > A, B. In another experiment, the four cellulose types were pre-irradiated in air, vacuum, and dry air with gamma rays and then reacted with styrene in methanol with and without the addition of water. The graft reaction follows the order vacuum > dry air > air. When C and D are irradiated in any of the three atmospheres, the graft reaction takes place in non-aqueous media, and water addition lowers the graft rate. But when A or B is irradiated in air, the graft reaction does not take place unless water is added. (D.L.C.)

23588 (AEC-tr-6316(p.100-4)) RADICALS PRODUCED IN IRRADIATED CELLULOSE. Shigeru Kawase. (Translation)

An ESR study was made of the radicals produced in polynoshics strong staple fiber by irradiation in vacuum or dry air, followed by decay under various conditions (high temperature, vacuum, air). The resulting spectra are discussed. (D.L.C.)

23589 (AEC-tr-6316(p.105-13)) RADIATION INDUCED GRAFT POLYMERIZATION ON POLYETHYLENE AND POLYPROPYLENE. Ichiro Sakurada, Norio Okada, and Tetsunari Shiota. (Translation)

The effects of variables on the gamma-induced graft polymerization of styrene of polyethylene and polypropylene were studied. These variables include solvents, irradiation temperature, grafting duration, dose and graft rate, preirradiation, and decay of graft activity. (D.L.C.)

23590 (AEC-tr-6316(p.121-8)) IR ABSORPTION SPECTRA OF POLYVINYL ALCOHOL BOTH HEATED AND HEATED WHILE BEING IRRADIATED. Ichiro Sakurada, Norio Okada, and Akiko Tanaka. (Translation)

The changes in the infrared spectra of dry PVA film induced by heating alone and by heating and gamma irradiation were studied for temperatures from 100 to 200°C. The results for both treatments are very similar and indicate that the $C = O$ and $C = C$ radicals increase, while the OH and CH_2 radicals decrease, with dose and temperature. The formation of many types of oxidation products also occurs. (D.L.C.)

23591 (AEC-tr-6316(p.129-30)) RADIATION-INDUCED LIQUID-PHASE ANIONIC POLYMERIZATION. Seizo Okamura, Koichiro Hayashi, Yoko Nakamura, and Masanobu Nishii. (Translation)

Experimental results are reported on the low-temperature radioinduced polymerization of liquid isopropyl amine to produce methyl methacrylate. The polymerization rate is proportional to the first power of the dose rate for rates $<10^3$ r/hr and constant for rates $>10^3$ r/hr. The degree of polymerization is proportional to the −0.4 power of the dose rate over the entire range. The effect of water addition is also studied. (D.L.C.)

23592 (AEC-tr-6316(p.131-3)) RADIATION INDUCED POLYMERIZATION OF VINYL ETHER. Seizo Okamura, Koichiro Hayashi, Yoko Nakamura, and Masanobu Nishii. (Translation)

Gamma-induced polymerizations of ethyl vinyl ether and isobutyl vinyl ether were carried out at room temperature in several solvents. These polymerizations probably occur by a free radical mechanism. No polymerization occurs at −78°C unless methylene chloride is used as solvent; this polymerization is probably ionic. (D.L.C.)

23593 (AEC-tr-6316(p.134-6)) LOW-TEMPERATURE RADIATION-INDUCED POLYMERIZATION OF VINYL ACETATE. NO. 2. PROPERTIES OF THE POLYMER AND ATTEMPTS AT SOLID-STATE POLYMERIZATION. Seizo Okamura, Koichiro Hayashi, and Kiyohiko Mori. (Translation)

The gamma-induced polymerization of vinyl acetate was extended through the temperature range −78 to +53°C, and properties of the resulting polyvinyl acetate and polyvinyl alcohol were measured. The results indicated that the polymerization degree of both polymers increased with decreasing temperature, reaching a maximum at ~0°C. Solid-state polymerizations were attempted at −196 to −100°C with no success. (D.L.C.)

23594 (AEC-tr-6316(p.137-44)) RADIATION-INDUCED POLYMERIZATION ON A GAMMA ALUMINA BASE. Seizo Okamura, Koichiro Hayashi, Yoko Nakamura, and Takao Natori. (Translation)

$\gamma-Al_2O_3$ was used in the gamma-induced copolymerizations of methyl methacrylate–styrene (MMA-ST) mixtures in toluene and of methyl methacrylate–acrylonitrile (MMA-AN) mixtures in dimethylformamide. The MMA-ST copolymerization was found to proceed via the anionic mechanism at −78 and −45°C and via the radical mechanism at 30°C. For MMA-AN, the copolymerization proceeds mainly by a radical mechanism with small anionic effects. The radioinduced polymerization of acetaldehyde, propionaldehyde, and benzaldehyde in the presence of $\gamma-Al_2O_3$ was investigated. (D.L.C.)

23595 (AEC-tr-6316(p.145-51)) EFFECT OF SILVER NITRATE ON RADIATION-INDUCED POLYMERIZATION OF ACRYLONITRILE DISSOLVED IN DIMETHYLFORMAMIDE. Seizo Okamura, Koichiro Hayashi, and Kenji Odan. (Translation)

Silver nitrate was studied with respect to its effects on the gamma-induced polymerization of acrylonitrile in dimethylformamide at 30, 0, and −78°C. The addition of silver nitrate was found to increase both the polymerization rate and the mean molecular weight. Several possible mechanisms for the effects are discussed. (D.L.C.)

23596 (AEC-tr-6316(p.152-3)) RADIATION-INDUCED POLYMERIZATION OF COMPOUNDS WITH TRIPLE BONDS. Seizo Okamura, Koichiro Hayashi, Kenji Odan, and Yoko Nakamura. (Translation)

Polymers were formed from acetonitrile, propionitrile, and isobutyronitrile by means of radioinduced reactions. The IR spectra of the products showed strong conjugated $-C{=}N-$ bonding. The G-values for the reactions were 8 to 20, and the degree of polymerization was ~10. Radioinduced polymerizations were also obtained with phenyl acetylene, propargyl alcohol, and propargyl bromide. ESR spectra of the products indicate unit polymer lengths of several decades of conjugated double bonds. (D.L.C.)

23597 (AEC-tr-6316(p.154-62)) RADIATION-INDUCED POLYMERIZATION OF UNSATURATED FIVE-MEMBERED RING COMPOUNDS. Seizo Okamura, Koichiro Hayashi, and Hakuo Hamada. (Translation)

The gamma-induced polymerization of cyclopentadiene, furan, pyrrole, and thiophene was investigated. The effects of dose rate, dose, temperature, solvent, and additives were studied in detail for cyclopentadiene; the results indicate an ionic mechanism. The activation energy was found to be positive below the melting point and negative above the melting point for cyclopentadiene, pyrrole, and thiophene. In mixtures of cyclopentadiene, furan, or pyrrole with trichloroacetic acid, polymers containing conjugated double bonds are produced. (D.L.C.)

23598 (AEC-tr-6316(p.163-7)) RADIATION-INDUCED POLYMERIZATION OF FORMALDEHYDE. NO. 2. LIQUID POLYMERIZATION. Seizo Okamura, Koichiro Hayashi, Nishi Yamaoka, and Yoko Nakamura. (Translation)

The effects of solvents on the radioinduced polymerization of formaldehyde in the production of polyoxymethylene were studied. The following order of polymerization rates was obtained: methylene chloride > toluene > ethyl ether. Tests on the formation of copolymers without solvent give the order isobutylene > styrene > methyl methacrylate, acrylonitrile. It is concluded that the polymerization proceeds by a cationic mechanism. The effects of water addition on the reaction in ethyl ether and on the thermolysis of the polymer were also studied. (D.L.C.)

23599 (AEC-tr-6316(p.168-73)) RADIATION-INDUCED POLYMERIZATION OF FORMALDEHYDE. Seizo Okamura, Koichiro Hayashi, and Masahiro Sakamoto. (Translation)

The Suikomi or input polymerization method, in which a catalyst is dispersed in a solvent and formaldehyde gas is swept into the medium, is discussed. The application of radiation to this method was studied using methylene chloride and tetrahydrofuran as solvents. The differences between the experimental and predicted yields are discussed. The melting points and viscosities of the products are given. (D.L.C.)

23600 (AEC-tr-6316(p.174-7)) RADIATION-INDUCED POLYMERIZATION OF GLYOXAL. Seizo Okamura, Koichiro Hayashi, and Kiyohiko Mori. (Translation)

Crystals of glyoxal which were crystallized at 0 and −78°C were gamma irradiated at 0, −78, and −196°C in air, and the polymer yields and structure were studied. The radioinduced copolymerization of formaldehyde and glyoxal in ether was also studied, and the properties of the products were measured. (D.L.C.)

23601 (AEC-tr-6316(p.178-81)) RADIATION-INDUCED POLYMERIZATION OF ACETONE TYPES. Seizo Okamura, Koichiro Hayashi, Kiyohiko Mori, and Yoko Nakamura. (Translation)

Polymers were formed from acetone, bromoacetone, chloroacetone, chlorinated acetone (a mixture of penta- and hexa-chloroacetone), methyl ethyl ketone, and diacetyl by low-temperature solid-state gamma irradiation. Yields were poor, and the polymers were not stable. (D.L.C.)

23602 (AEC-tr-6316(p.182-5)) RADIATION-INDUCED POLYMERIZATION OF TRIOXANE. Seizo Okamura, Koichiro Hayashi, Yoko Nakamura, and Masanobu Nishii. (Translation)

The possibility of forming polyoxymethylene polymers by irradiation of trioxane was investigated using a gamma or beta beam. The effects of temperature, time, and dose rate on the yield were studied. The stability of the product is superior to that of the polymer produced from formaldehyde. (D.L.C.)

23603 (AEC-tr-6316(p.186-9)) RADIATION-INDUCED POLYMERIZATION OF DIKETENE. Seizo Okamura, Koichiro Hayashi, and Yasuhisa Kitanishi. (Translation)

A polyester-type polymer was obtained by the gamma irradiation of diketene in the solid state. The effects of time, dose rate, and temperature indicate an ionic mechanism. Diketene also copolymerizes with acrylonitrile but not with styrene. (D.L.C.)

23604 (AEC-tr-6316(p.190-4)) RADIATION-INDUCED POLYMERIZATION OF β-PROPIOLACTONE. Seizo Okamura, Koichiro Hayashi, Yasuhisa Kitanishi, and Masanobu Nishii. (Translation)

The low-temperature solid-state radioinduced polymerization of β-propiolactone was investigated. The yield was found to reach saturation at 15 to 20%, and additional irradiation had no effect. Post-polymerization after irradiation and storage at low temperatures was studied. The effects of temperature on the rate were also studied. Copolymerizations of β-propiolactone with acrylonitrile, methyl methacrylate, styrene, and diketene were carried out at −78°C. The properties of the polymers obtained are described. (D.L.C.)

23605 (AEC-tr-6316(p.201-7)) RADIATION-INDUCED POLYMERIZATION OF MIXED CRYSTALS BY RING CLEAVAGE. Seizo Okamura, Koichiro Hayashi, and Masanobu Nishii. (Translation)

The effects of a second component on the radioinduced solid-state polymerization of β-propiolactone were investigated. The second components studied were acrylonitrile, γ-butyrolactone, diketene, and methanol. The effects of a solvent as the second component were also studied for methanol, ethyl ether, water, benzene, and acetone. The effects of irradiation time and temperature on the polymerization rate were determined. The composition and properties of the polymers obtained are described. The effects of several solvents on the polymerization of trioxane were investigated briefly. (D.L.C.)

23606 (AEC-tr-6316(p.208-11)) DYNAMICS OF RADIATION-INDUCED POLYMERIZATION BY RING CLEAVAGE. Seizo Okamura, Koichiro Hayashi, Yasuhisa Kitanishi, Haruhiko Watanabe, Masanobu Nishii, and Yoko Nakamura. (Translation)

Data are presented on the radioinduced solid-state polymerization of trioxane, diketene, β-propiolactone, and 3,3-bis(chloromethyl)cycloxabutane. The temperature effect was studied. Postirradiation polymerization was observed, and the effects of monomer crystal size on the polymerization are shown. A treatment of the polymerization dynamics is presented. (D.L.C.)

23607 (AEC-tr-6316(p.223-5)) GRAFT POLYMERIZATION OF POLYOXYMETHYLENE INDUCED BY IONIZING RADIATION. Seizo Okamura, Koichiro Hayashi, and Yoko Nakamura. (Translation)

Styrene, vinyl pyridine, and methyl methacrylate were graft polymerized onto polyoxymethylene in an effort to improve the properties of the resin. Both simultaneous and pre-irradiations were tried, and gamma and beta beams were used. The effects of the graft polymerization on the thermal stability are shown. (D.L.C.)

23608 (AEC-tr-6316(p.232-7)) STUDIES ON ELECTROLYTIC DISSOCIATION OF ALIPHATIC AMINES BY BETA BOMBARDMENT. Kozo Hirota, Hei Otoba, Kenji Fueki, and Motoyoshi Hatada. (Translation)

A mass spectrometric study was made of the products from the electron bombardment of methylamine, ethylamine, n-propylamine, isopropylamine, n-butylamine, isobutylamine, t-butylamine, dimethylamine, diethylamine, and di-n-propylamine. Ionization probability distributions and ionizing potentials were calculated. The various features of the mass spectra patterns are discussed. (D.L.C.)

23609 (AEC-tr-6316(p.238-44)) BETA-INDUCED EXCHANGE OF OXYGEN ATOMS BETWEEN CO_2 MOLECULES. Kozo Hirota, Hideo Terasaki, and Motoyoshi Hatada. (Translation)

The exchange reaction of CO_2 was studied using ^{18}O and a 1.5-Mev beta beam. The reaction was found to reach equilibrium after 3 hr, and the container walls had no effect on the reaction. The G value for the decrease of $C^{18}O_2$ was determined to be 0.35. The G value for the overall oxygen exchange reaction was calculated to be 10.5 and is compared with the values reported for radioinduced dissociation of CO_2. (D.L.C.)

23610 (AEC-tr-6316(p.245-52)) KETONE SYNTHESIS BY THE RADIATION-INDUCED REACTION BETWEEN ACETALDEHYDE AND ISOBUTYLENE. Progress Report. Kozo Hirota, Nobuji Iizuka, and Motoyoshi Hatada. (Translation)

Methyl isobutyl ketone and other byproducts are produced by the gamma-induced reaction between acetaldehyde and isobutylene. The effects of dose, dose rate, composition of starting material, irradiation temperature, and catalysts on the production of these compounds were studied. (D.L.C.)

23611 (AEC-tr-6316(p.253-60)) RADIATION-INDUCED REACTION BETWEEN ACETALDEHYDE AND ETHYLENE — MAINLY ON THE PRODUCTION OF METHYL ETHYL KETONE. Kozo Hirota, Hiroshi Ochi, and Motoyoshi Hatada. (Translation)

The radioinduced reaction of acetaldehyde with ethylene was investigated using a gamma source. The products are methyl ethyl ketone and minor amounts of methyl n-propyl ketone, paraldehyde, and methyl n-butyl ketone. The effects of irradiation time, dose rate, temperature, composition, and added water on the reaction were studied. (D.L.C.)

23612 (AEC-tr-6316(p.261-5)) GAMMA-INDUCED SYNTHESIS OF TERTIARY ALCOHOLS FROM A MIXTURE OF ISOPROPANOL AND ETHYLENE. Kozo Hirota and Motoyoshi Hatada. (Translation)

The products of gamma-irradiated mixtures of ethylene and isopropanol were analyzed with a gas chromatograph and a mass spectrometer. The results show that t-amyl alcohol (1 : 1 telomer), t-heptyl alcohol (1 : 2 telomer), t-nonyl alcohol (1 : 3 telomer), and t-unidecyl alcohol (1 : 4 telomer) were produced. The effects of dose rate, temperature, and ethylene-isopropanol ratio on the yields were studied. The experimental yields are in good agreement with predicted yields. (D.L.C.)

23613 (AEC-tr-6316(p.266-73)) GRAFT POLYMERIZATION OF POLYETHYLENE PREIRRADIATED IN AIR BY A (n,α) REACTION. Kozo Hirota, Masao Umezawa, and Junichi Takesaki. (Translation)

An attempt was made to improve the dyeability of the surface of polyethylene by alpha-induced graft polymerization of acrylonitrile and 2-methyl 5-vinyl pyridine. A sandwich of polyethylene sheets and a boric acid layer was irradiated in a research reactor so that one sheet was irradiated by gamma rays alone while another sheet was irradiated by both gamma rays and alpha particles from the $^{10}B(n,\alpha)$ reaction. The sandwich was then immersed in the vinyl monomer solution, and the graft rate was measured. The results show that alpha particles have a positive effect on the graft polymerization and that an improved dyeability was obtained. (D.L.C.)

23614 (AEC-tr-6316(p.283-94)) STUDIES OF THE USE OF ESR TO ELUCIDATE THE MECHANISMS OF RADIATION CHEMISTRY REACTIONS. Isamu Nitta and Shunichi Onishi. (Translation)

The ESR spectra of irradiated polyethylene show the existence of three radicals: $-CH_2-\dot{C}H-CH_2-$, $-CH_2-\dot{C}H-CH=CH-CH_2-$, and $-CH_2-\dot{C}H-(-CH=CH-)_n-CH-$. Polyethylene was irradiated under a variety of conditions, and the resulting radicals were studied through their ESR spectra. Both beta and gamma rays were used, and the decay of the radicals was studied. The mechanism of bridging reactions is discussed. (D.L.C.)

23615 (AEC-tr-6316(p.295-305)) RADICALS FORMED BY THE IRRADIATION OF POLYETHYLENE AND POLYPROPYLENE AND THE EFFECT OF PRETREATING THE MATERIALS. Isamu Nitta, Yuichi Ikeda, and Shunichi Onishi. (Translation)

The use of ESR spectra to follow free radicals is discussed. Experiments using beta- and gamma-irradiated polyethylene and polypropylene were performed to determine the best conditions for observing the ESR spectra and to study the effects of heat treatments and other pretreatments on the spectra. The various free radical species are discussed, and the results are discussed relative to the crystal structure of the polymers. (D.L.C.)

23616 (AEC-tr-6316(p.306-9)) ON THE SINGLET ESR SPECTRA OFTEN SEEN WHEN POLYMERS ARE EXPOSED TO A HIGH RADIATION FLUX. Isamu Nitta, Shunichi Onishi, Yuichi Ikeda, and Shunichi Sugimoto. (Translation)

The hyperfine structure of ESR spectra of irradiated polymers changes to singlets when the dose is increased greatly. Irradiation conditions for the appearance of singlets and the slope of the singlets are listed for polyvinyl chloride, polyethylene, rubber, polypropylene, polymethyl methacrylate, polyvinyl alcohol, β-carotene, and polyacetylene. With the exception of polypropylene, the polymers change in color from yellow-brown to brown on irradiation, and the slope of the singlets decreases with dose. The singlet is suggested to be a polyenyl radical ($-CH_2-CH-(-CH=CH-)_n-CH_2-$ for polyethylene), and evidence in support of the suggestion is discussed. (D.L.C.)

23617 (AEC-tr-6316(p.310-13)) OUTPUT SATURATION OF ESR SPECTRA OF IRRADIATED POLYMERS. Isamu Nitta, Shunichi Onishi, Yuichi Ikeda, and Shunichi Sugimoto. (Translation)

When microwave intensity into the cavity resonator exceeds a few mw, output saturation often occurs in the ESR spectra of irradiated polymers. Output saturation curves were measured and are plotted for polypropylene, peroxy radicals, polyvinyl alcohol, and polymethyl methacrylate. The results are discussed in terms of spin lattice relaxation times. (D.L.C.)

23618 (AEC-tr-6316(p.314-21)) RADICAL PRODUCTION CURVE OF IRRADIATED POLYMERS AS DETERMINED BY ESR. Isamu Nitta, Shunichi Onishi, Yuichi Ikeda, and Shunichi Sugimoto. (Translation)

Area measurements of ESR absorption spectral curves of irradiated polymers were used to determine the concentrations of induced radicals. Gamma and beta irradiations were made at room and liquid nitrogen temperatures, respectively, and the polymers studied were polyethylene, polypropylene, polyvinyl alcohol, polyvinyl chloride, cellulose, nylon, and polymethyl methacrylate. G values were calculated from the initial slopes of the radical production curves and are tabulated. (D.L.C.)

23619 (AEC-tr-6316(p.322-5)) STUDIES ON RADIATION-INDUCED OXIDATION OF POLYMERS. Isamu Nitta, Shunichi Onishi, and Shunichi Sugimoto. (Translation)

Electron spin resonance and infrared absorption spectra were used to study the oxidation behavior of free radicals in irradiated polymers. The ESR results show that the polymers can be classified into two groups according to the oxidation-induced changes in the ESR spectra. The oxidation reactions of polyethylene, polypropylene, polyvinyl chloride, and β-carotene are tabulated. (D.L.C.)

23620 (AEC-tr-6316(p.326-42)) STUDIES ON RADIATION-INDUCED OXIDATION OF POLYMERS. NO. 1. STUDIES ON RADIATION-INDUCED OXIDATION OF POLYETHYLENE USING ESR AND IR ABSORPTION. Isamu Nitta, Shunichi Onishi, and Shunichi Sugimoto. (Translation)

ESR and IR spectra were used to study the oxidation of free radicals in Marlex-50 film which was irradiated with either beta or gamma rays. It is concluded that, of the three free radical species, $-CH_2-\dot{C}H-CH=CH-CH_2-$(I) and $-CH_2-\dot{C}H-(CH=CH)_n-CH_2-$ are oxidized, while $-CH_2-\dot{C}H-CH_2-$ is not. A molecule of I is converted into 12 molecules of $C=O$ and 3 molecules of alcohol. (D.L.C.)

23621 (AEC-tr-6316(p.343-5)) STUDIES ON RADIATION-INDUCED OXIDATION OF POLYMERS. NO. 2. MECHANISM OF THE RADIATION-INDUCED OXIDATION OF POLYETHYLENE. Isamu Nitta, Shunichi Onishi, and Shunichi Sugimoto. (Translation)

An oxidation mechanism is proposed for the results described in Report No. 1. In this mechanism, the $-CH_2-\dot{C}H-CH_2-$ radical does not oxidize, while $-CH_2-\dot{C}H-CH=CH-CH_2-$ undergoes a chain reaction. For $-CH_2-CH-(CH=CH)_n-CH_2-$ radicals, the reaction begins with those of small n. Intramolecular reactions of the resulting peroxide radicals are proposed. (D.L.C.)

23622 (AEC-tr-6316(p.346-52)) STUDIES ON RADIATION-INDUCED OXIDATION OF POLYMERS. NO. 3. RADIATION-INDUCED OXIDATION OF POLYPROPYLENE. Isamu Nitta, Shunichi Onishi, and Shunichi Sugimoto. (Translation)

Irradiation of polypropylene in vacuum results in at least four free radical species: $-CH_2-C(CH_3)-CH_2-$, $-CH_2-C(CH_3)_2$, a short conjugated radical, and a long conjugated radical. Electron spin resonance and infrared spectra were used to follow the fate of these radicals in oxidation reactions in beta- and gamma-irradiated polypropylene. (D.L.C.)

23623 (AEC-tr-6316(p.353-8)) STUDIES ON RADIATION-INDUCED OXIDATION OF POLYMERS. NO. 4. RADIATION-INDUCED OXIDATION OF POLYVINYL CHLORIDE. Isamu Nitta, Shunichi Onishi, and Shunichi Sugimoto. (Translation)

PVC was gamma irradiated at various dose levels before exposure to air, and oxidation reactions were followed by ESR and infrared spectra. The effects of sample form on the oxidation reactions were also studied. The results are explained by oxidation of the free radicals, which become more sluggish with increasing length of the conjugated double bond systems. (D.L.C.)

23624 (AEC-tr-6316(p.368-80)) ON THE RADICALS FORMED BY THE IRRADIATION OF POLYPROPYLENE. Isamu Nitta, Shunichi Onishi, and Yuji Shioji. (Translation)

ESR spectra were used to study the free radicals created and captured in irradiated polypropylene. The effects of the radicals and the polymer state on the graft reaction with styrene were also determined. A G value of 6.2 was obtained for the formation of free radicals at −196°C. The radicals formed at −196°C in noncrystalline areas decay rapidly at room temperature. The graft rate of material irradiated at room temperature is greater than that irradiated at a very low temperature, indicating that the free radicals captured in the crystalline regions are effective in the graft reactions. (D.L.C.)

23625 (AEC-tr-6316(p.381-94)) MECHANISM OF THE RADIATION-INDUCED REACTIONS OF POLYVINYL CHLORIDE ESPECIALLY THE COLORING MECHANISM. Isamu Nitta, Shunichi Onishi, and Yoshiharu Nakajima. (Translation)

ESR and visible-uv spectra and observations on gas production were used to study the coloring mechanism in irradiated PVC. PVC irradiated at −196°C begins to color at ~−70°C. The degree of coloring is related to the length and concentration of the conjugated double bond systems and depends on the dose and temperature. The coloring at room temperature is due to conjugated double bond systems and depends on the dose and temperature. The coloring at room temperature is due to conjugated double bond systems formed by the zipper mechanism from radicals, while at higher temperatures (≥50°C), radicals are not involved in the formation mechanism. (D.L.C.)

23626 (AEC-tr-6316(p.431)) RADIATION-INDUCED COPOLYMERIZATION OF ETHYLENE AND TETRAFLUOROETHYLENE. Hiroshi Sobue and Yoneho Tabata. (Translation)

The radioinduced copolymerization of ethylene and tetrafluoroethylene was found to result in a polymer of uniform composition depending on the monomer ratio. The polymer exhibited crystallinity and interplanar spacings with a continuous variation between the spacings for the monomers, and its melting point changed in a continuous manner. (D.L.C.)

23627 (AEC-tr-6316(p.432-4)) RADIATION-INDUCED POLYMERIZATION OF ALKYL CYANIDES. Hiroshi Sobue and Yoneho Tabata. (Translation)

Radioinduced polymerizations of ethyl cyanide were carried out at 150 to −78°C. The results show that the mechanism is not simple and that ring compounds are probably present in the polymer. Polymerizations were also carried out in ethylene as solvent; the results show that the polymerization rate increases with ethylene content above 20%. (D.L.C.)

23628 (AEC-tr-6316(p.435)) LOW-TEMPERATURE RADIATION-INDUCED POLYMERIZATION OF ACETYLENE. Hiroshi Sobue and Yoneho Tabata. (Translation)

Gamma-induced polymerizations of acetylene were carried out in the liquid phase at −78°C and in the solid phase at −196°C. The mechanism is concluded to be cationic. The structure of the product obtained from the liquid phase was different from that of the solid phase. (D.L.C.)

23629 (AEC-tr-6316(p.436)) RADIATION-INDUCED ADDITION REACTION OF CHLORINE ON ACETYLENE. Hiroshi Sobue and Yoneho Tabata. (Translation)

Gamma-induced reactions of acetylene and chlorine were studied in the liquid phase at −78°C and in the solid phase at −196°C. A solution of a reaction product and a small amount of polymer was recovered at room temperature. The polymer contains double bonds and will polymerize if irradiated again. (D.L.C.)

23630 (AEC-tr-6316(p.437-8)) RADIATION-INDUCED POLYMERIZATION OF ACRYLONITRILE MIXED WITH ETHYLENE. Hiroshi Sobue and Yoneho Tabata. (Translation)

The radioinduced polymerization of acrylonitrile in ethylene solvent over the composition range is discussed. The products formed in dilute solutions have low $C\equiv N$ and high $C=N$ contents. A mechanism for this effect is suggested. (D.L.C.)

23631 (AEC-tr-6316(p.439)) RADIATION-INDUCED POLYMERIZATION OF DIMETHYLFORMAMIDE. Hiroshi Sobue and Yoneho Tabata. (Translation)

The gamma-induced polymerization of DMF with and without ethylene was studied at room temperature to −78°C. The polymerization with ethylene at −78°C was found to be due to the opening of the $C=O$ bond of DMF. Polymerization of pure DMF at room temperature is quite different, as the infrared spectrum of the product shows little change in the $C=O$ absorption. (D.L.C.)

23632 (AEC-tr-6316(p.440)) GAMMA-INDUCED POLYMERIZATION OF 4-VINYL PYRIDINE. Hiroshi Sobue, Yoneho Tabata, and Hakko Kitano. (Translation)

The polymerization approaches saturation with irradiation time, and the initial rate at room temperature is proportional to the square root of the dose rate. The liquid-phase polymerization takes place by a radical mechanism. No polymerization occurs in the solid phase at low temperatures. (D.L.C.)

23633 (AEC-tr-6316(p.441)) GAMMA-INDUCED POLYMERIZATION OF 5-ETHYL 2-VINYL PYRIDINE. Hiroshi Sobue, Yoneho Tabata, and Hakko Kitano. (Translation)

A small induction period is observed. The initial polymerization rate at room temperature is proportional to the square root of the dose rate, indicating a radical mechanism. Polymerization also occurs in the solid state at low temperatures; the mechanism is probably ionic. (D.L.C.)

23634 (AEC-tr-6316(p.442)) RADIATION-INDUCED POLYMERIZATION OF CHLORAL. Hiroshi Sobue and Yoneho Tabata. (Translation)

The gamma-induced polymerization of chloral was investigated from room temperature to −196°C. The polymerization in the liquid phase had very small activation energies, while in the solid phase near the melting point, the energies were large and negative. (D.L.C.)

23635 (AEC-tr-6316(p.443)) LOW-TEMPERATURE RADIATION-INDUCED POLYMERIZATION OF ETHYLENE. Hiroshi Sobue and Yoneho Tabata. (Translation)

Studies were made on liquid-phase polymerizations of ethylene. No induction period was observed, and the polymerization rate is proportional to the dose rate. The polymerization is speeded up by radical scavengers and solvents like methylene chloride. It is concluded that the polymerization proceeds by a cationic mechanism. (D.L.C.)

23636 (AEC-tr-6316(p.444-8)) CHANGES IN THE PROPERTIES OF NATURAL RUBBER ON IRRADIATION. Ryosuke Shimozawa, Yoneho Tabata, and Hiroshi Sobue. (Translation)

Various sensitizers were added to natural cis form rubber which was then gamma irradiated, and the transformation into the trans form was studied. The transformation was found to be accomplished at a relatively low dose rate and to be a reversible first order reaction. The efficiency of the sensitizers is in the following order: n-butyl mercaptan > butyl sulfide > diphenyl sulfide > ethylene bromide. (D.L.C.)

23637 (AEC-tr-6316(p.449-55)) EFFECTS OF GAMMA RADIATION ON NATURAL RUBBER IN CONTACT WITH SO_2. Ryosuke Shimozawa, Yoneho Tabata, and Hiroshi Sobue. (Translation)

Crosslinking resulting from the gamma irradiation of natural Hevea gum in the presence of SO_2 was investigated using solid rubber and toluene solutions. The results show that radioinduced crosslinking is increased by SO_2 and that the SO_2 is taken into the rubber matrix in the $R-SO_2-R$ form as both intermolecular and intramolecular groups. (D.L.C.)

23638 (AEC-tr-6316(p.456-64)) RADIATION-INDUCED POLYMERIZATION OF ISOPRENE. Hiroshi Sobue, Yoneho Tabata, and Ryosuke Shimozawa. (Translation)

The bulk polymerization of isoprene was studied at 40 to −78°C using gamma radiation, and the product yield and structure were studied. The effects of additives (DPPH, pyridine, and acetone) and dose rate were determined. The reaction takes place by a radical mechanism at high temperatures and a cation mechanism at low temperatures, and both mechanisms occur in the temperature range 40 to −78°C. (D.L.C.)

23639 (AEC-tr-6316(p.465-8)) LOW-TEMPERATURE RADIATION-INDUCED POLYMERIZATION OF ACRYLONITRILE. Hiroshi Sobue, Yoneho Tabata, and Masahiko Hiraoka. (Translation)

An attempt was made to produce stereoisomeric polymers by gamma irradiation of acrylonitrile−urea complexes at −78°C. The percent conversion and limiting viscosity of the products were measured. Urea was found to have no effect on the rate, viscosity, or infrared spectrum of the product. The reaction probably takes place by a radical mechanism. (D.L.C.)

23640 (AEC-tr-6316(p.469-70)) RADIATION-INDUCED POLYMERIZATION OF TETRAFLUOROETHYLENE. Hiroshi Sobue, Yoneho Tabata, and Hiroshi Shibano. (Translation)

The radioinduced polymerization of tetrafluoroethylene was successfully carried out in both liquid (−20 to −78°C) and solid (below −140°C) phases. For the liquid-phase polymerizations, an induction period is present, the G value is ~10^6, and the mechanism probably involves radicals. For the solid-state polymerizations, there is no induction period, and the mechanism is ionic. (D.L.C.)

23641 (AEC-tr-6316(p.471-80)) RADIATION-INDUCED POLYMERIZATION OF ACROLEIN DIETHYL ETHER. Kunio Araki, Motonobu Ichino, and Shigeo Hoshino. (Translation)

The radioinduced polymerization of acrolein diethyl ether ($CH_2=CHCH(OC_2H_5)_2$) and copolymerization with acrylonitrile were attempted using gamma radiation. The homopolymerization is relatively slow, and the product had a degree of polymerization of 3 to 4. The results indicate that a degradative chain transfer occurs in the polymerization. Acrolein diethyl ether forms a copolymer with acrylonitrile, but its reactivity is small. Infrared spectral measurements of the monomer, homopolymer, and copolymer were made. (D.L.C.)

23642 (AEC-tr-6316(p.481-97)) GRAFT COPOLYMERIZATION OF POLYETHYLENE WITH PROPYLENE AND ANHYDROUS SO_2. Ayao Amamiya and Seishiro Sekigawa. (Translation)

In an attempt to obtain improved properties such as dyeability and thermal resistance, the grafting of propylene−SO_2 to polyethylene was carried out using gamma simultaneous and pre-irradiation. The structure of the graft polymer was determined, and its dyeability, tensile properties, thermal resistance, and alkali resistance were measured. (D.L.C.)

23643 (AEC-tr-6316(p.498-500)) RADIATION-INDUCED GRAFT POLYMERIZATION ON CELLULOSE. Shoji Shida, Zenichiro Kuri, and Takayuki Yoshimura. (Translation)

The radioinduced graft polymerization of styrene on viscose was attempted using gamma radiation in air. There is considerable scatter in the graft rate data, especially at higher doses, and the addition of sodium sulfite increases the graft rate, indicating an oxygen effect. The effects of acrylamide on the acid treatment yield were studied. (D.L.C.)

23644 (AEC-tr-6316(p.509-15)) DOUBLET-QUINTET ESR SPECTRA OF IRRADIATED TETRAFLUOROETHYLENE. Naoyuki Tamura. (Translation)

The temperature effect on the doublet-quintet ESR spectra of the fluoroalkyl radical ($-CF_2-\dot{C}F-CF_2-$) in irradiated polytetrafluoroethylene was investigated. The changes in line width near the transition temperature were compared with NMR and viscosity data and correlated with the structure. It is concluded that the changes result from intracrystalline rotational motions. (D.L.C.)

23645 (AEC-tr-6316(p.516-21)) ESR OF TETRAFLUOROETHYLENE IRRADIATED AT LOW TEMPERATURE. Naoyuki Tamura. (Translation)

Irradiations of polytetrafluoroethylene were carried out at liquid nitrogen temperature, and ESR measurements were made. The results show the existence of a radical which decays at low temperature, probably $-CF_2-CF_2\cdot$ produced by the severing of molecular chains. The radical decay is closely related to the crystallinity and to crystal imperfections in melted and unmelted crystals. (D.L.C.)

23646 (AEC-tr-6316(p.522-5)) ESR OF POLYCARBONATES. [PART] I. Kyuji Kashiwabara and Kenichi Shinohara. (Translation)

The behavior of the free radicals in gamma-irradiated polycarbonates was studied by ESR measurements. The spectra indicate that an unpaired electron exists in the oxygen and that the radical decay takes place by an ideal bimolecular reaction mechanism. The radicals are completely gone at ~140°C. When polycarbonate is irradiated in vacuum at −196°C and then allowed to come to room temperature, light is emitted. (D.L.C.)

23647 (AEC-tr-6316(p.526-33)) ESR OF IRRADIATED POLYETHYLENE. Kyuji Kashiwabara and Kenichi Shinohara. (Translation)

Low temperature irradiations and ESR measurements at various temperatures were carried out on Marlex 50 and Sumikathene with particular emphasis on the reactive elements responsible for crosslinking. The temperature effects on the stable radicals were studied. The results indicate that the spectral changes may be related to the second transition. Some comments are given on saturation effects in ESR spectra. (D.L.C.)

23648 (AEC-tr-6316(p.534-7)) ESR OF IRRADIATED TEFLON AND THE EFFECTS OF SEVERAL CASES. Kenichi Shinohara and Teikichi Matsugashita. (Translation)

ESR spectra were used to study Teflon which was gamma irradiated in vacuum and then exposed to hydrogen, deuterium, methane, ethane, oxygen, and nitric oxide. The results are interpreted in terms of reaction rates. (D.L.C.)

23649 (AEC-tr-6316(p.538-50)) ESR ABSORPTION OF SEVERAL IRRADIATED ALCOHOLS. Ayao Amamiya, Naoyuki Tamura, and Seiji Ogawa. (Translation)

Attempts were made to identify the radicals produced by gamma irradiation of the following alcohols: cyclohexanediol-1,4; syndiotactic pentanediol-2,4; polyvinyl alcohol; 2,3-butanediol; mesoerythritol; and pentaerythritol. The results show a monotonous effect of beta H. The radical from 1,3-type glycol is $-CH_2-C(OH)-CH_2-$, while radicals with an H removed can be assigned to 1,2-type glycols. Temperature effects probably due to radical self conversion were observed. (D.L.C.)

23650 (AEC-tr-6316(p.567-72)) ESR STUDY OF THE REACTIONS OF IRRADIATED ACRYLAMIDE AND META-ACRYLAMIDE WITH GASES. Hisashi Ueda, Zenichiro Kuri, and Shoji Shida. (Translation)

Studies were made of the reactivities of radicals produced by irradiation of acrylamide and meta-acrylamide monomers and polymers. The reactivities were measured by ESR measurements of the reactions with NO, H_2S, O_2, and SO_2 gases. (D.L.C.)

23651 (AEC-tr-6316(p.573-86)) ESR ABSORPTION OF RADICALS FORMED IN SUGARS. Hisashi Ueda, Zenichiro Kuri, and Shoji Shida. (Translation)

A study was made of the stable radicals formed in crystals of monomer sugars by irradiation. The sugars studied included arabinose, ribose, xylose, glucose, galactose, fructose, sorbose, saccharose, cellobiose, maltose, lactose, raffinose, Na−CMC, sodium alginate, cellulose, starch, PVA, acetyl cellulose, inulin, and sucrose. The effects of water, atmosphere, and heat treatment were studied. The dissolution of irradiated sugar was found to initiate polymerization of acrylamide. It is concluded that the radicals produced in the sugars are stabilized by hydrogen bonds which prevent reactions with gases and thermal decomposition. (D.L.C.)

23652 (AEC-tr-6316(p.587-97)) ESR ABSORPTION OF IRRADIATED ACRYLAMIDE AND META-ACRYLAMIDE.

Hisashi Ueda, Zenichiro Kuri, and Shoji Shida. (Translation)

Acrylamide and meta-acrylamide monomers were irradiated to various doses and then heated, and changes in the radicals due to the heat treatment were studied. These radicals are compared with those found in irradiated polyacrylamide and polymeta-acrylamide. Polymer yields of irradiated and heat-treated monomers were also determined. (D.L.C.)

23653 (AEC-tr-6316(p.598-602)) FREE RADICALS FROM POLYMERS IRRADIATED WITH UV. Yuzuru Fujiwara, Zenichiro Kuri, and Shoji Shida. (Translation)

Polyvinyl alcohol and polyvinyl chloride were irradiated by low-energy uv light, and the ESR spectra of the free radicals were compared with those from gamma irradiation. The results show that uv irradiation produces a low concentration of relatively stable free radicals on the surface. Preliminary results from uv irradiation of polymethyl methacrylate and Teflon are also described. (D.L.C.)

23654 (AEC-tr-6316(p.609-15)) DYNAMICS OF FREE RADICAL FORMATION IN POLYMERS. Yuzuru Fujiwara, Zenichiro Kuri, and Shoji Shida. (Translation)

The theory of a diffusion-controlled formation of free radicals is considered. Some experimental ESR data are reported for gamma-irradiated polyvinyl alcohol; they show that the rate-determining step is diffusion-controlled, although the uneven radical distribution makes calculations difficult. The reactions are mainly bimolecular, although first-order reactions do occur. (D.L.C.)

23655 (AEC-tr-6316(p.616-22)) RADIATION-INDUCED OXIDATION OF CYCLOHEXANE. NO. 2. EFFECT OF TEMPERATURE. Koji Tsuruta, Shoji Shida, and Zenichiro Kuri. (Translation)

The effects of raising the temperature on the G values for cyclohexanol and cyclohexanone production in the gamma irradiation of cyclohexane in air were studied at temperatures up to 130°C. The results show that the G values are increased and the ratio of cyclohexanone to cyclohexanol increases with temperature and irradiation. Activation energies and chain lengths were calculated. The effects of a post heat treatment on a beta-irradiated cyclohexane were studied. (D.L.C.)

23656 (AEC-tr-6316(p.623-39)) RADIATION-INDUCED OXIDATION OF PHENYL CYCLOHEXANE. Kunio Araki, Toshihiko Abe, and Shigeo Hoshino. (Translation)

The gamma-induced oxidation of phenyl cyclohexane was studied by evolved gas yields, spectrophotometry, ESR, oxygen absorption, and peroxide yields. Gases evolved by phenyl cyclohexane–cyclohexane mixtures were also studied. The results are discussed in detail. (D.L.C.)

23657 (AEC-tr-6316(p.640-9)) ON THE GRAFT POLYMERIZATION OF VINYL MONOMERS ON POLYETHYLENE TEREPHTHALATE. Kazuo Araki, Koji Otsubo, and Shigeo Hoshino. (Translation)

Graft reactions of styrene, 2-methyl-5-vinyl pyridine, and acrylic acid on film, monofilament, and cord-type PETP were carried out by simultaneous gamma irradiation under vacuum. The tensile and adhesion properties of the polymers were measured. It is concluded that the graft rate is controlled by the diffusion of monomer into PETP. (D.L.C.)

23658 (AEC-tr-6316(p.650-9)) RADIATION-INDUCED GRAFT POLYMERIZATION ON CELLULOSE. Kunio Araki, Motonobu Ichino, and Shigeo Hoshino. (Translation)

Smooth graft polymerizations of styrene, methyl methacrylate, acrylonitrile, and 2-vinyl pyridine on cotton and rayon were accomplished without the need for a swelling agent. Treatment of the cellulose with hot water or mixed solvents was effected before the simultaneous or preirradiation with gamma rays. The effects of the treatment were less marked for rayon than for cotton. The results are discussed in terms of cellulose structure. (D.L.C.)

23659 (AEC-tr-6316(p.669-71)) RADIATION-INDUCED ADDITION REACTIONS OF POLYHALIDES—ON THE ADDITION REACTIONS UNIQUELY INDUCED BY RADIATION. Kunio Araki. (Translation)

In the gamma-induced addition of polyhalides to olefins, a nominal addition product and an unique product containing one chlorine atom less than the nominal product are formed. For example, CCl_4 and CCl_3COOCH_3 react with 1-octene to give $C_6H_{13}CHClCH_2CCl_3$ (nominal) and $C_6H_{13}CH_2CH_2CCl_3$ (unique), and $C_6H_{13}CHClCH_2CCl_2COOCH_3$ and $C_6H_{13}CH_2CH_2CCl_2COOH$, respectively. Similarly, $CHCl_3$ and $CHCl_2COOCH_3$ react with 1-octene to give $C_6H_{13}CH_2CH_2CCl_3$ and $C_6H_{13}CH_2CH_2CHCl_2$, and $C_6H_{13}CH_2CH_2CCl_2COOCH_3$ and $C_6H_{13}CH_2CH_2CHClCOOCH_3$. (D.L.C.)

23660 (AEC-tr-6316(p.672-5)) FORMATION OF RADIATION-INDUCED GRAFT POLYMERS IN POLYMER–POLYMER–SOLVENT SYSTEM. Kunio Araki, Toshihiko Abe, and Shigeo Hoshino. (Translation)

An attempt was made to produce a polyvinyl chloride–polyvinyl pyridine polymer by gamma irradiation of a tetrahydrofuran solution of the two polymers. A 2×10^6 rad dose results in a polymer with unusual solubility properties and of composition 39% polyvinyl chloride and 61% polyvinyl pyridine. (D.L.C.)

23661 (UCRL-Trans-1048(L)) LUMINESCENT PHENOMENA AND ZIRCONIA RESEARCH. Berthold C. Weber. Translated by Senta Pugh (Univ. of California, Lawrence Radiation Lab., Livermore), from Keram. Z., 15: 192-8(1963). 27p.

The nature of luminescence and the fluorescence and phosphorescence observed with zirconia compositions and their reaction products are discussed and explained. With the aid of photographs taken in the dark under irradiation by short-wave uv light it is shown how far it is safe to rely on the observations as a method of analysis for the identification of crystal modifications. The colors of the luminescence are stated on the basis of their visual impressions. (P.C.H.)

23662 NOTE ON THE INCREASE IN RADIOLUMINESCENCE EFFICIENCY ACCOMPANYING A DECREASE IN AVERAGE MOLECULAR WEIGHT OF THE POLYSTYRENE SOLVENT. Z. Polacki (Technical Univ., Danzig). Acta Phys. Polon., 25: 273-6(Feb. 1964).

An attempt is made to explain the dependence of the radioluminescence efficiency of binary and ternary plastic scintillation solutions on the average molecular weight of polystyrene. The assumption is made that the quantum scintillation efficiency of polystyrene is proportional to the number of polystyrene molecules in unit volume. From this assumption, the radioluminescence efficiency was calculated as a function of the intrinsic viscosity (with some additional simplifications). The calculated function was compared with the experimentally obtained dependence of the relative technical radioluminescence efficiency on the intrinsic viscosity. (auth)

23663 DOSE RATE EFFECT OF CHEMICAL DOSIMETRY WITH CHLORAL HYDRATE. Shigeru Okabe, Kunihiko Tsumori, and Kenichi Sugimoto. Ann. Rept. Radiation Center Osaka Prefect., 4: 65-6(1963).

The effects of ^{60}Co gamma rays on the electric conductivity of chloral hydrate, $CCl_3CH(OH)_2$, was investigated. A definite dose rate effect was observed. The temperature effect of the ionization coefficient was fairly large and temperature rise is inevitable in the electron irradiation dosimetry. It was concluded that electron dosimetry seems impossible using halogen compounds. (P.C.H.)

23664 OPTICAL QUENCHING OF ESR SIGNALS IN NEUTRON IRRADIATED ZnS. Yoshihiko Shono, Shigeharu Koshino, and Toshio Yoshida. Ann. Rept. Radiation Center Prefect., 4: 71(1963).

A cubic crystal of pure ZnS was irradiated with total flux of fast neutrons at about 7×10^{16} nvt. No intense photosensitive signal was observed after irradiation except the signal $g = 2.0027$. The signal suffered no change from any rotation of the crystal. Therefore, it was concluded that the environment of the center responsible for the signal has a cubic symmetry. The signal was quenched with a visible light of about 4000 to 6000 Å. An overall shift of quenching spectrum to a longer wavelength with increasing temperature was interpreted in terms of thermal effects. (P.C.H.)

23665 RADIATION INDUCED PHASE TRANSITION IN ZnS. Shigeharu Koshino, Takashi Oka, and Toshio Yoshida. Ann. Rept. Radiation Center Osaka Prefect., 4: 72(1963).

Zinc sulfide crystals were irradiated with fast neutrons at a total flux of the order of 10^{16} nvt. X-ray diffraction was used for the detection of phase transition. The intensity of x-ray diffraction by cubic (311) planes was compared with that of diffraction by hexagonal (112) planes. It was concluded that neutron irradiation of the order of 10^{16} nvt is able to induce an appreciable amount of phase transition in ZnS. (P.C.H.)

23666 THE RADIATION INDUCED ISOMERIZATION OF BUTENE-2. Wataru Ando and Ken'ichi Sugimoto. Ann. Rept. Radiation Center Osaka Prefect., 4: 90-2 (1963).

Studies were made on the effects of Ar, I_2, NO, SO_2, ethyl bromide, and diphenyl disulfide on the radioinduced isomerization of trans-butene-2. Argon and iodine were without effect. Sulfur dioxide and nitric oxide produced about 15% isomerization of trans-butene-2 to cis-butene-2, which are explained by the production of vibrationally excited triplet states. On the other hand, the effect of ethyl bromide and diphenyl disulfide for the isomerization was explained as the radical addition to the trans-butene-2. (P.C.H.)

23667 THE RADIATION INDUCED ISOMERIZATION OF BUTENE-2 ON METALLIC OXIDES. Wataru Ando and Ken'ichi Sugimoto. Ann. Rept. Radiation Center Osaka Prefect., 4: 93-5(1963).

Gamma irradiation was used to obtain the effect on the surface properties of metallic oxide catalysts for the cis-trans isomerization of 2-butene. Evidence of increasing the conversion ratio of trans-butene-2 during irradiation due to a short-lived induced catalytic activity was obtained. The influence of Ar was also investigated during irradiation. The addition of Ar decreased the conversion ratio of the isomerization, since Ar gas is bound to the surface of the catalyst, which might decrease the activity of the catalyst. The oxides used were those of Al, Si, Ti, Zn, Mg, Cu, Fe, V, and Cr. (P.C.H.)

23668 THE RADIATION INDUCED ADDITIONS OF HYDROGEN SULFIDE TO OLEFINS. Ken'ichi Sugimoto and Wataru Ando. Ann. Rept. Radiation Center Osaka Prefect., 4: 96-102(1963).

Results of studies on the γ ray initiated free radical additions of H_2S to some olefinic compounds are presented. Radioinduced additions of H_2S to propene, isobutene, trans-butene, and 2-butene took place very readily, giving mainly the mercaptans and the sulfides and reached completion at room temperature with a relatively small radiation dose, the G-values of these reactions were found to be more than ten thousand. It is speculated that the reaction proceeds through a free radical chain process, where sulfhydryl radicals formed in the initial step of the radiolysis of H_2S undergo radical addition to the olefin. Data are tabulated. (P.C.H.)

23669 GAS EVOLUTION AND THE FORMATION OF DOUBLE BONDS DURING THE RADIOLYSIS OF POLYISOBUTYLENE. E. N. Teleshov, A. S. Teleshov, N. V. Desyatova, A. N. Pravednikov, and S. S. Medvedev. Dokl. Akad. Nauk SSSR, 154: 1402-5(Feb. 21, 1964). (In Russian)

Polyisobutylene (PIB) film was irradiated with ^{60}Co γ rays or with 200-kev electrons at temperatures of −180 to +50°C. According to the mass-spectrometric data, the gas formed at room temperature contains H_2, CH_4, and small amounts of isobutylene (G yield = 0.1 mol/100 ev) and ethane. The total yield of $H_2 + CH_4$ was 2.3 mol/100 ev, and did not depend on the irradiation temperature. The gas contained 20% methane ($G = 0.46$) on irradiation above the solidification temperature of PIB, and only 10% methane on irradiation below the PIB solidification temperature (−78 to −196°C). Analogous results were previously obtained on irradiating other polymers containing free methyl groups such as polydimethylsiloxane, polymethacrylic acid, and poly-α-methylstyrene. It was determined by infrared spectroscopy that 0.86 double bonds are formed for each broken bond independently of the irradiation temperature. The data showed that on heating an irradiated PIB sample from −196°C to room temperature, free radicals are destroyed, but there is no increase in gaseous products, or in the number of double bonds in the polymer. An increase in the number of double bonds would ordinarily be expected. It is hypothesized that cyclopropane or cyclopentane rings should be formed as a result of free radical destruction, but an attempt to detect these groups by infrared was unsuccessful because of strong absorption by the CH group in this region. (TTT)

23670 FREE-RADICAL REACTIONS DURING THE INTERACTION OF OXYGEN WITH IRRADIATED POTASSIUM PALMITATE. A. A. Revina and N. A. Bakh (Inst. of Electrochemistry, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 155: 410-13(Mar. 11, 1964). (In Russian)

Potassium palmitate (PP) was irradiated in vacuum at 77°K with ^{60}Co γ rays at a dose rate of 5×10^{16} ev/g sec to an absorbed dose of 5.4×10^{20} ev/g. Electron paramagnetic resonance (EPR) spectra were taken at 298°K with an oxygen pressure of 10^{-6} to 400 mm Hg std. The data indicated that the reaction of irradiated potassium palmitate with O_2 is completely reversible at pressures of a few mm Hg std. The balance between the disappearance of $\dot{R}$ radicals and the appearance of $\dot{R}O_2$ radicals depended significantly on the oxygen pressure. At an O_2 pressure of 180 mm Hg std, all initial $\dot{R}$ radicals were converted to $R\dot{O}_2$ radicals within a time of ~30 minutes. The overall radical concentration also increased with the appearance of $R\dot{O}_2$. The formation of RO_2^* radicals was very slow at an O_2 pressure of 0.045 mm Hg std. The results can be interpreted on the basis of the following reactions: $R^- + O_2 \rightarrow \dot{R} + O_2^-$ (1), $\dot{R} + O_2 \rightarrow R\dot{O}_2$ (2), $2R + O_2 \rightarrow (2R,O_2)$ (3), and and $(2R,O_2) \rightarrow \dot{R} + R\dot{O}_2$ (4). The consumption of O_2 is determined by reactions 1), 2), and 3) in the early stages, and the decrease in radicals is determined by reaction 3). In the final stage, the consumption of O_2 is determined by reactions 1) and 2) after reaction 4) takes place, and the total radical concentration is determined by the initial value and increase according to reaction 1). (TTT)

23671 STABILIZATION OF SPONTANEOUS POLARIZATION AND PYROEFFECT IN γ IRRADIATED TRIGLYCINE SULFATE CRYSTALS. V. A. Yurin and I. S. Zheludev. Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 726-30(Apr. 1964). (In Russian)

Diagrams were constructed of spontaneous polarization in triglycine sulfate as functions of radiation dose and temperature. Spontaneous polarization in triglycine sulfate is stabilized (as in seignetto salts) such that external electric fields do not effect crystal orientation. (R.V.J.)

23672 CATALYTIC DEHYDRATION OF CYCLOHEXANOL OVER MAGNESIUM SULFATE CONTAINING ADMIXTURES OF PROTACTINIUM 231. V. I. Spitsyn, A. A. Balandin, N. P. Dobrosel'skaya, and R. A. D'yachkova (Inst. of Physical Chemistry, Academy of Sciences, USSR and Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Khim., No. 3, 564-5(1964). (In Russian)

It was found that ^{231}Pa α particles do not affect the catalytic activity of magnesium sulfate in the dehydration of cyclohexanol. (R.V.J.)

23673 THERMOGRAVIMETRIC ANALYSIS OF THE EFFECT OF IONIZING RADIATION ON THERMAL STABILITY OF POLYETHYLENE. Shoichi Igarashi, Itaru Mita, and Hirotaro Kambe (Tokyo Univ.). J. Appl. Polymer Sci., 8: 1455-64(May 1964).

The effect of radiation on thermal and oxidative degradation of polyethylene was studied by thermogravimetric analysis. It was found that the thermal stability of polyethylene irradiated in a vacuum and in air at room temperature decreases with increasing radiation dose. In nitrogen the thermal decomposition of irradiated polyethylenes occurs in one stage without marked influences of the irradiation atmosphere. In the presence of air, oxidative degradation takes place in three stages, on which irradiation atmosphere has great effect. This is due to the difference in the chemical structure of irradiated polyethylenes. (auth)

23674 RADIOLYTIC REDUCTION OF KIO_3 POTASSIUM IODATE IN AN ALKALINE MEDIUM. M. Haissinsky, J. Jove, and W. Szymanski (Laboratorie Curie, Paris). J. Chim. Phys., 61: 572-6(Apr. 1964). (In French)

Alkaline solutions of KIO_3 have been irradiated by gamma radiation in the presence (or absence) of oxygen, and the yields (G) of reduction and water decomposition have been measured as functions of the concentration and pH (from 12.2 to 13.8). At pH 13.15 the following values have been found: $G_{e_{aq}} - G_{OH} = 0.40$; $G_{H_2} = 0.40$; and $G_{H_2O_2} = 0.60$. For pH 12.2 and 13.8, $2G_{H_2O_2} + G_{e_{aq}} - G_{OH}$, $G_{H_2O_2}$, and $G_{e_{aq}} - G_{OH}$ have been calculated separately. (tr-auth)

23675 YIELDS OF H_2O_2 FROM THE RADIOLYSIS OF AQUEOUS SOLUTIONS BY ALPHA PARTICLES AT 5.3 Mev. Maria do Carmo Anta, Maria Helena Mariano, and Manuel Lima e Santos (Lab. for Nuclear Physics and Engineering, Sacavém, Portugal). J. Chim. Phys., 61: 577-83 (Apr. 1964). (In French)

A study is made of the initial formation of hydrogen peroxide by ^{210}Po alpha particles in 0.4 $\underline{M}$ H_2SO_4, in the presence and absence of various other solutes. The yield (G) of H_2O_2 is, for doses on the order of 1.5×10^{18} ev/cm^3, 1.41, as compared with $G(Fe^{3+}) = 5.1$. $G(H_2O_2)$ decreases slowly in proportion as the dose increases. $G(H_2O_2)$ is not influenced by the presence of cerous ions at 10^{-5} to 10^{-3} $\underline{M}$, or of NO_3^- ions at 10^{-5} to 2×10^{-2} $\underline{M}$. However, for higher concentrations of these solutes, $G(H_2O_2)$ falls off as the logarithm of their concentration. Measurements in the presence of Tl^+, Cl^-, or Br^- at 10^{-5} to 10^{-1} $\underline{M}$ show that the diminution of the $G(H_2O_2)$ produced by their presence is proportional to their concentrations raised to the powers 0.27, 0.33, and 0.33, respectively. The interpretation of the results permits the value of the primary yield of H_2O_2 in the radiolysis of water by 5.3-Mev alpha particles to be deduced. The variations of $G(H_2O_2)$ with Tl^+, Cl^-, and Br^- concentrations are consistent with calculations based on a cylindrical diffusion model having one radical. (tr-auth)

23676 BENZENE PRODUCTION IN THE RADIATION CHEMISTRY OF ACETYLENE. F. H. Field (Humble Oil and Refining Co., Baytown, Tex.). J. Phys. Chem., 68: 1039-47(May 1964).

Benzene production by the irradiation of acetylene was investigated as a function of pressure (3 to 200 torr) at 30 and 80°C and at 30°C in the presence of added Ar, H_2, and mixtures of Ar and H_2. In the experiments with pure C_2H_2 the fractions of reacted C_2H_2 converted to C_6H_6 and $G(C_6H_6)$ pass through maxima at 20 to 30 torr, and the amount of C_6H_6 formed increases with temperature. The range of C_6H_6 yield values found is 0.23 to 0.46, and the range of $G(C_6H_6)$ is 5.1 to 13.0. Values of $G(-C_2H_2)$ are essentially invariant with pressure, but the average value increases from 68 to 91 when the temperature is increased from 30 to 80°C. The fraction of reacted C_2H_2 converted to C_6H_6 is independent of radiation intensity, but $G(C_6H_6)$ and $G(-C_2H_2)$ drop sharply between 6×10^{12} and 42×10^{12} ev/cm^3 sec but then do not change much as the intensity is increased further. A reaction model and mathematical analysis are given, and a calculated C_6H_6 yield curve of the same form as that observed experimentally is obtained. The addition of both Ar and H_2 by themselves lowers the amount of C_6H_6 formed, but the addition of Ar to a $C_2H_2-H_2$ mixture has no significant additional effect. The addition of Ar decreases $G(-C_2H_2)$ significantly, but the effect of the addition of H_2 is much less marked. From the effect on $G(-C_2H_2)$ it was concluded that at relatively low pressures both Ar and H_2 are efficient in transferring energy to C_2H_2, but at higher pressures the efficiency decreases. The addition of H_2 depresses the value of $G(C_6H_6)$ more strongly than does Ar. The experiments indicate that C_2H_3 is not greatly involved in C_6H_6 production. In addition, the results obtained pose a question as to whether an ionic mechanism is involved in polymer production. (auth)

23677 HYDRIDE ION TRANSFER AND RADIOLYSIS REACTIONS IN PENTANE AND ISOPENTANE. J. H. Green and D. M. Pinkerton (Univ. of New South Wales, Sydney). J. Phys. Chem., 68: 1107-11(May 1964).

The rates of hydride ion transfer reactions leading to the $C_5H_{11}^+$ ion in pentane and isopentane were measured. The rates are briefly discussed with relevance to the radiolysis of pentane. (auth)

23678 PULSE RADIOLYSIS STUDIES. V. TRANSIENT SPECTRA AND RATE CONSTANTS IN OXYGENATED AQUEOUS SOLUTIONS. Gideon Czapski and Leon M. Dorfman (Argonne National Lab., Ill.). J. Phys. Chem., 68: 1169-77(May 1964).

The optical absorption spectra and reaction kinetics of transient species in oxygenated aqueous solutions were investigated over the pH range 2 to 14 using the pulse radiolysis technique. The HO_2 radical spectrum has a maximum at 230 mμ with a molar extinction coefficient of $\epsilon_{HO_2}^{230}$ = 1150 M^{-1} cm^{-1} at 25°. The O_2^- has a maximum at 240 mμ with $\epsilon_{O_2^-}^{240}$ = 1060 M^{-1} cm^{-1}. The pK of the hydroperoxy radical was found to be 4.5 ± 0.2. The absolute rate constants for the bimolecular disappearance of these transients at 25°C were determined to be: $k_{HO_2+HO_2} = 2.7 \times 10^6$ M^{-1} sec^{-1}, and $k_{O_2^-+O_2^-} = 1.7 \times 10^7$ M^{-1} sec^{-1}. In alkaline solution above pH 10, two new transient species were observed, one with a maximum at 240 mμ, the other with a maximum at 430 mμ. Both species decayed according to a first-order rate law with a pH-dependent half life, the former in the range of seconds, the latter in the range of milliseconds. The possible identity of these transient species is discussed. (auth)

23679 ELECTRON SPIN RESONANCE STUDY OF X-RAY IRRADIATED, ORIENTED POLYPROPYLENE. Ramdas P. Gupta (Institut fur Electrowerkstoffe, Freiburg i. B.). J. Phys. Chem., 68: 1229-31(May 1964).

A paramagnetic resonance investigation was made on the effect of stretching on molecular orientation in x-irradiated polypropylene. Samples of polypropylene were stretched in the form of thread and then irradiated by a weak x-ray source to 0.5 × 10^6 r. The line shape in the EPR spectra changes with the change in the orientation of the draw axis of the polypropylene specimen with respect to the direction of the magnetic field. The change in line intensity with orientation is quite marked. The line intensity is at a maximum for the 0° orientation and decreases continuously as the orientation angle increases, until 90°, at which it is at a minimum. Then it increases again until 180°, where the intensity is at a maximum once more. (P.C.H.)

23680 ISOTOPE EXCHANGE IN GASEOUS NITROGEN UNDER X-RAY AND COBALT-60 γ-IRRADIATION. M. Anbar and P. Perlstein (Weizmann Inst. of Science, Rehovoth, Israel and Soreq Research Establishment, Rehovoth, Israel). J. Phys. Chem., 68: 1234-7(May 1964).

The radiolytically induced isotopic exchange reaction between $^{14,14}N_2$ and $^{15,15}N_2$ was investigated and attempts were made to elucidate its mechanism. Different dose rates, pressures, and sources of radiation were used. However, it was found that the radiolytic yield of exchange is independent of pressure from 440 to 100 mm; G_{exch} = 9.5 ± 0.25. The G value was found independent of dose rate between 5.75 × 10^5 and 6.23 × 10^6 rads/hr and was equal for x rays and ^{60}Co gamma rays. Also the G value found shows little temperature dependence in the range of temperatures used. It was concluded that the mechanism of exchange involves reactive species formed under radiolysis, which do not react with each other and do not act as chain carriers. (P.C.H.)

23681 MECHANISM OF THE DEPENDENCE OF YIELDS UPON pH AND SOLUTE CONCENTRATION IN THE γ-IRRADIATION OF WATER. E. Hayon (CEN, Saclay, France). J. Phys. Chem., 68: 1242-4(May 1964).

The mechanism of the effects of pH and solute concentration on hydrogen yields in the gamma radiolysis of water was investigated. Using two-solute systems, one solute to react with electrons (KNO_3 or acetone) and another to react with H atoms (2-propanol) to give H_2, $H + RH_2 \rightarrow H_2 + RH$, G_H was determined by measuring H_2. The solutions were thoroughly degassed and irradiated with ^{60}Co gamma rays, and the hydrogen gas was determined by gas chromatography. The precursors of molecular H are mainly electrons and yields in 0.5 M KNO_3 and 1.0M acetone are 0.15 and 0.16, respectively. In neutral solutions containing 2-propanol, $G(H_2)$ is 0.73 in 0.5 M nitrate and 0.68 in 1.0 M acetone, that is $G(H_2) \simeq G_{H_2} + G_H$. Since addition of relatively high concentrations of electron scavengers such as nitrate ions and acetone reduces considerably G_{H_2} but has no effect on G_H, it was concluded that the main precursor of the H atom is not an electron that reacts in the spur with H^+. (P.C.H.)

23682 INFLUENCE OF TEMPERATURE ON THE RADIATION-INDUCED BRANCHING OF POLYISOBUTENE MOLECULES. D. T. Turner (Research Triangle Inst., Durham, N. C.). J. Phys. Chem., 68: 1255-7(May 1964).

The effects of temperature on the radiolysis of polyisobutene was investigated by comparison of the ratio of the limiting viscosity numbers of branched and linear polymers of the same average molecular weight. The (M_W, [η]) results obtained after irradiation at −196°C lie sufficiently below those obtained at higher temperatures to demonstrate unequivocally that the polymers are extensively branched. (P.C.H.)

23683 THE ULTRAVIOLET SPECTRA OF TRANSIENTS PRODUCED IN THE RADIOLYSIS OF AQUEOUS SOLUTIONS. S. Gordon, E. J. Hart, and J. K. Thomas (Argonne National Lab., Ill.). J. Phys. Chem., 68: 1262-4(May 1964).

The uv spectra of several transients were observed in the radiolysis of aqueous solutions of H_2SO_4, isopropyl alcohol, acetone, and o-, p-, and m-phthalate by 15-Mev electrons down to 2000 Å. Spectra of the transients are discussed. (P.C.H.)

23684 RADIATION-INDUCED COPOLYMERIZATION OF TETRAFLUOROETHYLENE WITH PROPYLENE AT LOW TEMPERATURE. Yoneho Tabata, Kenkichi Ishigure, and Hiroshi Sobue (Tokyo Univ.). J. Polymer Sci., Pt. A, 2: 2235-43(May 1964).

Radioinduced copolymerization of tetrafluoroethylene with propylene was carried out at low temperature in the liquid phase. The resulting copolymers were found to range from viscous oils to rubberlike materials, depending on the polymerization conditions. It was observed that there are induction periods in these copolymerizations, and that the rate of copolymerization is proportional to the square root of the dose rate. Fluorine contents of the copolymers were determined, and the monomer reactivity ratios in the copolymerization were found to be $r_{C_3H_6}$ = 1.0 and $r_{C_2F_4}$ = 0.06. The viscosity of the copolymer was measured in tetrahydrofuran at 30°C. Infrared spectra of the copolymers were also measured. It was concluded that the copolymerization proceeds by a radical mechanism. (auth)

23685 COPOLYMERIZATION OF TETRAFLUOROETHYLENE WITH ISOBUTENE INDUCED BY IONIZING RADIATION. Yoneho Tabata, Kenkichi Ishigure, Keichi Oshima, and Hiroshi Sobue (Tokyo Univ.). J. Polymer Sci., Pt. A, 2: 2445-53(May 1964).

Radioinduced copolymerization of tetrafluoroethylene with isobutene was carried out in the liquid state of the monomers at low temperature. The composition curve of the tetrafluoroethylene–isobutene copolymer was obtained. Infrared spectra, x-ray diffraction, and melting points of the copolymers obtained were also measured. It was concluded from the experimental results that an alternating crystalline isobutene–tetrafluoroethylene copolymer can be obtained by a radical process induced by ionizing radiation. This seems to be the first case in which an alternating crystalline copolymer was obtained by a radical mechanism over an extremely wide range of molar concentration of the components in the monomer mixture. (auth)

23686 CAPTURE OF LOW-ENERGY ELECTRONS IN CHLOROBENZENE AND BROMOBENZENE. J. A. Stockdale, G. S. Hurst, and L. G. Christophorou (Oak Ridge National Lab., Tenn.). Nature, 202: 459-61(May 2, 1964).

The interaction of electrons with C_6H_5Cl and C_6H_5Br from thermal energies to 10 ev was investigated. A permanent non-dissociative process in which thermal electrons are captured and a dissociative process peaking at an electron energy of about 0.76 ev for C_6H_5Cl and 0.7 ev for C_6H_5Br were observed. The products of the dissociative process were found to be Cl^- and Br^-. Integrated dissociation cross sections and electron attachment coefficients are computed. (C.E.S.)

23687 RADIOLYTIC AND PHOTOLYTIC REDUCTION OF AQUEOUS SILVER NITRATE SOLUTIONS. H. A. Mahlman and T. E. Willmarth (Oak Ridge National Lab., Tenn.). Nature, 202: 590-1(May 9, 1964).

The formation of silver metal from aqueous silver nitrate solutions by the action of light, gamma rays, and alpha particles is reported. (C.E.S.)

23688 ANOMALOUS BACK-SCATTERING OF ELECTRON IRRADIATION ON VEGETABLE OIL-PLASTIC SYSTEMS. T. Tuchscheerer (Bundesforschungsanstalt fur Lebensmittelfrischhaltung, Karlsruhe, Ger.). Naturwissenschaften, 51: 60(1964). (In German)

If soybean oil is irradiated under a plastic covering, a reaction occurs between the oil and film, which leads to an increased electron flux backwards to the generator exit window (scanner). In irradiation of soybean oil under saran film the scanner current climbed to nearly four times the original adjusted value and then fell and then climbed back to the initial value. The intensity of the back-scattering, measured as scanner current, was essentially greater than was expected from its order-number dependence. This back-scattering was not constant and there existed no limiting thickness of the irradiated material. (M.C.G.)

23689 RADIATION-INITIATED POLYMERIZATION. PART 2. SEARCH FOR NEW FLUOROPOLYMERS. P. J. Manno (Continental Oil Co., Houston, Tex.). Nucleonics, 22: No. 6, 64-7(June 1964).

Application of radiation screening to the polymers produced from a family of commercially attractive monomers has verified the value of screening and has uncovered two interesting plastics. (auth)

23690 RADIATION EFFECT ON THE SURFACE PHENOMENA OF BIOLOGICAL MACROMOLECULES IN THE SOLUTION. Tomio Matsuura and Toshiko Sugimura (Tokyo Univ.). Proc. Fac. Eng. Tokai Univ., 2: 25-9(July 1963). (In Japanese)

X-ray effects on mobility and conductivity were studied, using polyacrylic acid (polymerization degrees, 800 and 2000) as an analogue of a biological macromolecule and dioxane as a solvent. The x rays used were mainly 70 kvp 2ma. The dose rate was changed from 2.15 to 0.0048 r/sec. The number of significant figures in the conductivity and dielectric constant measurements was 5. For 10% polyacrylic acid in dioxane, which has a low conductivity and low dielectric constant, the change in conductivity was proportional to the dose up to about 20 r. The proportional constant increased with dose rate below 0.1 r/sec. In this region, the G-value was about 1 and the variation in conductance was more than 10^{-3} at a dose of 20 r; but the variation was little when high frequencies were used. By infrared spectrometry, the chemical shift of the carboxyl radical in polyacrylic acid was found not to be influenced by the x rays and only the absorption bands of dioxane were found in the ultraviolet and visible regions. The phenomena mentioned above seem to have resulted from the stabilization of ions formed in dioxane solution and caught by the colloidal polyacrylic acid molecules. The variation in dielectric constant was less than 10^{-4} in several irradiations by x rays. (Nucl. Sci. Abstracts of Japan)

23691 THE ABSORPTION SPECTRUM AND SOME REACTION CONSTANTS OF THE HYDRATED ELECTRON. J. P. Keene (Christie Hospital, Manchester, Eng. and Holt Radium Inst., Manchester, Eng.). Radiation Res., 22: 1-13 (May 1964).

The technique of pulse radiolysis was used to observe the presence of radiation-produced hydrated electrons in water and various aqueous solutions at room temperature. The results obtained were used to get an accurate absorption spectrum for hydrated electrons and also to calculate rate constants for their reactions with hydrogen ions, hydrogen peroxide, oxygen, nitrous oxide, and water. Their reactions with other radiation-produced species were also detected in water at high dose rates. (auth)

23692 PULSE RADIOLYSIS OF FERROUS SULFATE SOLUTION. J. P. Keene (Christie Hospital, Manchester, Eng. and Holt Radium Inst., Manchester, Eng.). Radiation Res., 22: 14-20(May 1964).

It is shown that the pulse radiolysis technique can be used to separate some of the reactions occurring in the oxidation of ferrous sulfate by radiation. With 10 $m\underline{M}$ ferrous sulfate in $\underline{N}$ sulfuric acid, four stages were observed, widely separated in time. During the earlier stages, changes in the absorption spectrum occurred; these are interpreted as being due to the presence of various forms of the ferric ion at different times. The slowest stage took several seconds to go to completion and is due to hydrogen peroxide oxidation with a rate constant of $61.9 M^{-1}$ sec^{-1} (±5%) at 20°C. The most rapid stage was complete in a few microseconds even in 0.2 $m\underline{M}$ solution and is interpreted as being due to OH oxidation (to form uncomplexed ferric ion) with a rate constant greater than $10^8 \underline{M}^{-1}$ sec^{-1}. The two intermediate stages were consistent with oxidation by HO_2 to form the hydroxyl complex with a rate constant of $7.3 \times 10^5 \underline{M}^{-1}$ sec^{-1} (±10%), followed by buildup of the sulfate complex from uncomplexed ferric. The interpretation given of the early stages of the reaction cannot be regarded as conclusive in view of their complicated nature and the limited amount of data. (auth)

23693 EMISSION CHARACTERISTICS OF ZnS-PHOSPHORS EXCITED BY TRITIUM β-RAYS. Masamichi Ikeda (Tokyo Metropolitan Isotope Centre), Lyuji Ozawa, Kazuto Hata, Yoshiharu Shinozaki, and Gisuke Meshitsuka. Radioisotopes (Tokyo), 13: 115-17(Mar. 1964). (In Japanese)

The emission characteristics of ZnS phosphors excited by tritium gas are described. As phosphors cubic – ZnS: Cu:Cl(ϕ = μ) and hex-5 ZnS · 5 CdS:Ag:Cl(ϕ = 6μ), which gave the most intense emission, were used. Inner walls of a 9 mmϕ glass globe and a 5 mmϕ glass cylinder were coated with monolayer of phosphor crystals. After evaluating the globe or cylinder, tritium gas (>96%, 2C) was introduced by a Toepler pump. Emission intensity was measured by RCA-931 A photomultiplier tube. The relation between emission intensity and pressure of tritium gas is illustrated. Emission intensity increased with increasing tritium gas pressure, but in the high-pressure region, the emission efficiency decreased gradually. The phenomena can be explained by the self-absorption of tritium β rays. The emission intensity is proportional to the apparent radioactivity (N) and the self-absorption coefficient (μ) is proportional to the pressure of tritium gas. (P.C.H.)

23694 CHEMICAL CHANGES IN THE COMPOSITION OF PENTAVALENT ANTIMONY PHENYL DERIVATIVES DURING THE β DECAY OF ^{125}Sb. V. D. Nefedov, I. S. Kirin, and V. M. Zaitsev. Radiokhimiya, 6: 78-85(1964). (In Russian)

The following metal organic compounds of pentavalent antimony containing tracer ^{125}Sb were synthesized: $^{125}Sb(C_6H_5)_5$, $^{125}Sb(C_6H_5)_4Cl$, and $^{125}Sb(C_6H_5)_2Cl_3$. The specific activity of the compounds was ~1 mC/g. The accumulation of ^{125m}Te in crystals of these compounds was observed at room temperature for a period of 4 to 5 half lives of ^{125m}Te(T = 58 days), and at a temperature of liquid oxygen for the $^{125}Sb(C_6H_5)_5$ compound. The chemical forms of ^{125m}Te were identified by adding $Te(C_6H_5)_4$, $Te(C_6H_5)_3Cl$, $Te(C_6H_5)_2Cl_2$, $Te(C_6H_5)_2$, and $Te(C_6H_5)Cl_3$ as carriers, and separating from the antimony compounds by paper partition chromatography. The amounts of ^{125}Sb and ^{125m}Te were determined by γ spectroscopy. With the $^{125}Sb(C_6H_5)_5$ compound, the main chemical forms of ^{125m}Te at room temperature were found to be $Te(C_6H_5)_4$ with a yield of 60 ± 5% and $R_f = 0.80$, and $Te(C_6H_5)_3Cl$ with a yield of 30 ± 5% and $R_f = 0.10$. The relative yield of $Te(C_6H_5)_4$ increased by ~5% at −183°C. With the $^{125}Sb(C_6H_5)_4Cl$ compound, the yield of $Te(C_6H_5)_3Cl$ was 75 ± 10%, and the remainder of the ^{125m}Te was distributed between $Te(C_6H_5)_2Cl_2$ and $Te(C_6H_5)_4$. With the $^{125}Sb(C_6H_5)_2Cl_3$ compound, the yield of $^{125m}Te(C_6H_5)_2Cl_2$ was 72 ± 6%, and the yield of $^{125m}Te(C_6H_5)Cl_3$ was 20 ± 6%. Consideration of the beta energies and binding energies showed that radioactive recoil is not important in these reactions. Rather, the explanation must be sought in the breakdown of positive tellurium radicals according to the following general reaction: $[TeR_3Cl_2]^+ \rightarrow TeR_2Cl_2 + R^+$. (TTT)

23695 USE OF THE CHEMICAL EFFECTS OF THE β-DECAY OF ANTIMONY-125 FOR THE SYNTHESIS OF TRI-α-NAPHTHYLAMINE TELLURIUM DERIVATIVES. V. D. Nefedov, I. S. Kirin, and V. M. Zaitsev. Radiokhimiya, 6: 123-4(1964). (In Russian)

The molecular ions formed by the β decay process of atoms composing a given molecular system may be used to synthesize new compounds of the daughter element. This method was used to establish the existence of α-methyl derivatives of Te by synthesizing them by the β decay of ^{125}Sb, a component of $Sb(^{125}Sb)(\alpha-C_{10}H_7)_3$. The ^{125m}Te daughter element was accumulated at room temperature. Chromatographic analysis indicated that 83 ± 6% of all the ^{125}Te present was in the form of $^{125m}Te(\alpha-C_{10}H_7)_3Cl$; the rest as $^{125m}Te(\alpha-C_{10}H_7)_2$. The tri-$\alpha$-naphthyl tellurium compounds were synthesized by classical methods, using Grignard's reagent. This chloride formed colorless crystals, soluble in water, alcohol, and chloroform and had a melting point of 193°. By varying the starting materials and the experimental conditions, such as heating, irradiation, etc., various compounds of the daughter element may be formed. (TTT)

23696 EFFECT OF THE RADIOACTIVE RADIATION OF SULFUR-35 AND MOLYBDENUM-99 ON THE SIZE OF THE SPECIFIC SURFACE OF MOLYBDENUM DISULFIDE. Vikt. I. Spitsyn, I. E. Zimakov, and N. P. Dobrosel'skaya. Radiokhimiya, 6: 130-2(1964). (In Russian)

In the study of heterogeneous processes occurring at the solid-gas and solid-liquid interface, the effect of radiation on the specific surface must be taken into account. This problem was investigated in the case of MoS_2, prepared by melting together MoO_3 and elementary S with Na_2CO_3, using either ^{99}Mo or ^{35}S. The composition of the product was determined gravimetrically as $PbMoO_4$ and $BaSO_4$, ascertaining that both radioactive and nonradioactive preparations corresponded to MoS_2. The specific surface of the material was calculated from the amount of Kr adsorbed at low temperatures. It was found that the specific surface of the radioactive preparation was higher than that of the inactive one; it was increased with increasing activity. When the compound contained ^{35}S, the specific surface increased proportionally with the activity, reaching a threefold value at 30 mC/g; introduction of ^{99}Mo resulted in a more abrupt increase. Comparing preparations with identical activities, it was found that the surface of Mo^*S_2 is considerably larger than that of MoS_2^*. Thus, the energy of the β radiation of the isotope affects considerably the surface of the solids formed. On the other hand, the effect of the activity on the specific surface was negligible after the formation of the compound. (TTT)

23697 POSITIVE-ION CHEMISTRY: HIGH YIELDS OF HEAVY HYDROCARBONS FROM SOLID METHANE BY IONIZING RADIATION. Donald R. Davis and W. F. Libby (Univ. of California, Los Angeles). Science, 144: 991-2 (May 22, 1964).

At 77°K solid methane is polymerized rapidly and efficiently to heavy hydrocarbons by ^{60}Co rays. The product is a viscous oil consisting mainly of saturated and highly branched hydrocarbons containing an average of about 20 C atoms per molecule. This would seem to be evidence for positive-ion chemical reactions in the solid state analogous to those previously reported to occur in the gaseous state at pressures above 0.01 mm Hg. It would thus appear that the solar ionizing uv radiation (about 1 erg/cm^2/sec at the earth) must polymerize methane at an appreciable rate under many likely conditions. (auth)

Separation Processes and Procedures

Refer also to abstract 24929.

23698 (CEA-R-2404) PURIFICATION DES SOLVANTS PAR ENTRAINEMENT A LA VAPEUR D'EAU. PROCÉDÉ CONTINU APPLICABLE AUX USINES CHIMIQUES DE TRAITEMENT DES COMBUSTIBLES IRRADIÉS. (Solvent Purification by Carry-Over in Water Vapor. A Continuous Process Applicable to Chemical Plants Treating Irradiated Fuels). Pierre Raymond Auchapt, Roger Robert Sautray, and Bernard Rene Girard (France. Commissariat à l'Energie Atomique. Centre de Production de Plutonium de Marcoule, Chusclan). Apr. 1964. 101p.

A pilot plant is described for the continuous purification of the solvent used in the plutonium extraction plant at Marcoule, by separating the impurities (fission products). This physical separation is operated by carrying over in a water vapor stream. The contaminating products, only slightly volatile, remain in the form of droplets and are separated; the vaporized solvent and water vapor used are condensed and then separated. A system for pulverizing the liquid and operating conditions of low working pressure and temperature are used. A systematic analysis of the various parameters (percentage of residue, flow, pressure, and temperature ratios, etc.) showed their influence on the decontamination. The activity due to zirconium–niobium was undetectable after treatment, and it was easy to obtain decontamination factors of 300 for ruthenium. The presence of uranium was favorable for the decontamination. The approximate cost price of the treated solvent per liter is discussed. (auth)

23699 (CONF-405-37) CHEMICAL DIFFERENCES BETWEEN THE LANTHANIDES AND TRIVALENT ACTINIDES. Boyd Weaver (Oak Ridge National Lab., Tenn.). [1964]. Contract [W-7405-eng-26]. 13p.

From the 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

Some of the differences in the ion-exchange and solvent-extraction properties of lanthanides and trivalent actinides are described. Actinides were preferentially eluted from cation exchanger Dowex 50 with saturated alcoholic solutions of HCl. The lanthanides were preferentially eluted from the anion exchanger Dowex 1 by 13$\underline{M}$ HCl. The trivalent actinides could also be held on anion exchanges as thiocyanate complexes while the lanthanides were eluted. Actinides could be extracted from concentrated aqueous lithium chloride solutions by hydrocarbon solutions of tertiary amine chloride solutions while lanthanides remained in the aqueous solution. Actinides were also more extractable with TBP. Other solvents also had different extraction efficients for the two groups of rare earths. (M.C.G.)

23700 (DP-876) REMOVAL OF CESIUM FROM EVAPORATOR CONDENSATE. William E. Prout and Edwin R. Russell (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Mar. 1964. Contract AT(07-2)-1. 17p.

An ion exchange process was developed to remove cesium from condensate solutions produced when aged highly radioactive waste solutions are evaporated at the Savannah River Plant. The cesium is removed from the condensate in a single pass through a fixed bed of "Decalso," an aluminosilicate gel. In laboratory tests with actual condensate, about 99% of the cesium was removed from 10,000 bed volumes of feed before regeneration of the bed was required. (auth)

23701 (NAA-SR-8888(Sect.V)) SEPARATIONS CHEMISTRY. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). 16p.

The broad objective of the program is to help achieve lower cost electrical power from nuclear reactors by reducing fuel-cycle costs. The specific objective of the program is to investigate new low-decontamination methods for reprocessing reactor fuels, and to further the development of effective laboratory methods that appear to be adaptable to larger scale operation. Results of fuel cycle evaluation studies continue to be encouraging. Computer calculations to predict the effect of fission products on re-enrichment requirements for recycle of UO_2 fuel were carried out by use of an updated library of fission products revised to include resonance absorption cross sections. These studies show that for nine 15,000 Mwd/MTU cycles, the average ^{235}U burnup is ~15% higher for reprocessing by oxidation-reduction (AIROX) than by a process that completely removes fission products. The total fuel cycle cost is ~10% lower by the oxidation-reduction reprocess than by aqueous reprocessing. The higher burnup costs are more than offset by the relatively simple fuel cycle. Computer calculations were carried out to predict the effect of fission products on re-enrichment requirements for recycle of UC fuel reprocessed by oxidation-carbothermic reduction (CARBOX). The average additional ^{235}U burnup required by recycle, relative to fully decontaminated fuel, is less than the additional ^{235}U burnup for UO_2 reprocessed by the AIROX process. Fuel cycle evaluation studies indicate a savings over aqueous reprocessing. The results of kilogram scale experiments have shown that UC of controlled composition can be prepared by reacting U_3O_8 with carbon. The reaction proceeds in two stages: reduction to UO_2 at 900°C with the formation of CO_2, and the high temperature (1100 to 1750°C) reduction to UC with the formation of CO. The UO_2 produced in the first step is more reactive than UO_2 commercially available and the conversion to UC proceeds at a lower temperature. In connection with studies on control of carbon content in UC, uranium metal containing <300 ppm oxygen, and 100 ppm carbon was prepared by the carbothermic reduction of UO_2 in a UO_2 crucible. It appears that the method merits consideration for the preparation of uranium metal. Radiochemical analysis of irradiated UO_2 (5,000 to 15,000 Mwd/MTU), which was reprocessed by AIROX and refabricated by cold pressing and sintering at 1700°C, showed almost complete removal of cesium during the sintering operation but essentially no removal of plutonium or rare earths. The capsules containing the refabricated UO_2 were inserted in the MTR for reirradiation. Irradiation was completed on UO_2 containing fissia simulating a burnup of 100,000 Mwd/MTU. Preparations for postirradiation examination of these materials were initiated. Small-scale experiments have shown that appreciable fission product removal is achieved in both the nitride and the CARBOX reprocessing methods for UC. Fission product removals for the nitride process were as follows: cesium, 90 to 99%; cerium, 20 to 60%; strontium, 90 to 99%; Zr-Nb, 1 to 15%; ruthenium, 0 to 30%; and rare earths, 40 to 70%. Fission product removals for the CARBOX process (including arc-melting) were: cesium, >99%; cerium, 85 to 98%; and strontium, >99%. These decontamination factors should be adequate for reprocessing power reactor fuels but loss of plutonium during arc-melting may be a major difficulty. If plutonium losses, as observed on gram scale experiments with tracer irradiated material, are an indication of what can be expected in larger scale reprocessing of power reactor fuels, other methods of refabrication should be investigated. Substantial progress was made in determining the mechanism of "activation" of UC. It appears that hydrolysis along grain boundaries caused by atmospheric moisture results in a marked increase in surface area. It appears that UC, prepared from UO_2, containing "fissia" is somewhat less reactive than UC itself, and "activates" more slowly. Results of the first kilogram scale UC oxidation experiment using the rotary furnace were quite satisfactory. Ninety-eight per cent of the product was -200 mesh and appeared suitable for preparation for preparation of uranium carbide by carbothermic reduction. Experiments show that uranium carbide can be removed from stainless steel cladding by nitrogen treatment at 750 to 850°C by a process similar to that used in decladding UC or UO_2 with oxygen. (auth)

23702 (ORNL-3566) RECOVERY OF PLUTONIUM AND OTHER TRANSURANIUM ELEMENTS FROM IRRADIATED PLUTONIUM-ALUMINUM ALLOY BY ION EXCHANGE METHODS. R. E. Brooksbank and W. T. McDuffee (Oak Ridge National Lab., Tenn.). May 1964. Contract W-7405-eng-26. 71p.

In order to isolate plutonium and other transuranium elements such as americium and curium from the aluminum in highly irradiated Pu-Al alloy fuel elements, an ion exchange process was demonstrated. The process is described in detail and results from the developmental work and the pilot plant demonstration are given. The process consisted of dissolving the fuel rods in 6$\underline{M}$ HNO_3-0.05$\underline{M}$ Hg^{2+}-0.03$\underline{M}$ F^-, adjusting the valence of the plutonium to four, and clarifying the solution by filtration through a sand-bed filter precoated with filter aid, after which the plutonium was recovered by sorption on anion exchange resin. The sorbed plutonium then was scrubbed free of aluminum and fission products with 7M HNO_3–0.01M F^- The partly purified plutonium was then eluted from the resin with 0.7M HNO_3. Additional purification and decontamination were obtained by repeating the ion exchange step. The plutonium product, meeting radiation specifications, was nearly free of aluminum and was decontaminated from fission products by a factor of 4.6×10^5. Overall plutonium recovery processing losses of 2.7 and 12.6%, respectively, occurred with fuel elements irradiated to 87 and greater than 97% burnup. The transuranium elements were then recovered from the aluminum-bearing, plutonium loading waste effluent solution, which was collected and stored during the plutonium-recovery phase of the program. The free acid in the raw wastes was removed by evaporation to 140°C, after which the concentrate was diluted with water until the concentration of the aluminum was 2.5 to 2.8M. At this point, the aluminum nitrate was nearly monobasic. After clarification to remove the aluminum hydroxide that was formed, the rare earths and transuranium elements were sorbed on anion exchange resin at 60°C. Traces of aluminum and light fission products that were sorbed on the resin were scrubbed from it with 8M $LiNO_3$. The purified rare earth fraction containing the transuranium elements was then eluted from the resin with 0.7M HNO_3 and evaporated to small volume. The conditions developed and demonstrated in the recommended flowsheet for the recovery of plutonium and other transuranium elements from irradiated Pu–Al alloy fuel permitted average dissolution rates of the alloy of about 0.8 mg min^{-1} cm^{-2} and resulted in plutonium recoveries greater than 97%. Some reduction in plutonium recovery may be expected, however, as the burnup of the fuel elements approaches 99% because of the destruction or masking of the exchange sites on the resin. In the runs described, resin exposure to the radiation was sufficient in two instances to destroy about 35% of the exchange sites, a rather serious defect of the process. Transuranium element recoveries greater than 95% were demonstrated operating according to the recommended flowsheet developed during this program. High recovery of the transuranium elements depended on their complete recovery from the aluminum hydroxide cake collected during the clarification step. The cake retained about 35% of the transuranium elements, which could be recovered by rinsing with dilute nitric acid and returning to the evaporator. High salting strength (8M NO_3^-) was necessary in the feed and scrub solutions in the ion exchange step. The products, plutonium and transuranium elements, are nearly free of aluminum after this process and therefore adaptable to subsequent processes for isolating and recovering them. (auth)

23703 (ORNL-TM-789) LABORATORY DEVELOPMENT OF A PROCESS FOR CHLORINATING THE COMBUSTION ASH FROM GRAPHITE FUELS CONTAINING ThC_2 AND UC_2 AND RECOVERING THE URANIUM BY SOLVENT EXTRACTION FROM A SOLUTION OF THE CHLORINATION PRODUCTS. T. A. Gens (Oak Ridge National Lab. Tenn.). May 11, 1964. Contract [W-7405-eng-26]. 22p.

A process was investigated for recovering uranium from uranium carbide–thorium carbide–graphite fuels by burning, chlorinating the ash, dissolving the product in 6N HCl, concentrating the chloride solution, and recovering the uranium by solvent extraction. The main objective of the work was to perform the combustion, chlorination, and dissolution in a single vessel, thereby avoiding a transfer of the combustion ash. The process appears adaptable to large-scale use only if corrosion rates of 20 mils/month are acceptable in the burner-chlorinator. Construction materials that do not corrode rapidly in chloride solutions must be used in the feed preparation and the first solvent extraction cycle. (auth)

23704 (ORNL-TM-828) A LABORATORY STUDY OF THE SEPARATION AND RECOVERY OF URANIUM AND PLUTONIUM FROM FISSION PRODUCTS BY CHLORIDE VOLATILITY. J. H. Goode (Oak Ridge National Lab., Tenn.). Apr. 2, 1964. Contract W-7405-eng-26. 27p.

Ten hot cell experiments were made to test a proposal for the recovery and decontamination of uranium from UO_2 fuels by a chloride volatility system. The UO_2 was converted to U_3O_8 by heating in oxygen at 500 to 800°C, the oxide was chlorinated and volatilized as UCl_5–UCl_4 with 85% Cl_2—15% CCl_4 vapors at 500°C, and the chlorides purified or decontaminated by fractional distillation and sublimation. Uranium recovery varied from 90 to 98%. The losses were caused by incomplete chlorination and/or sublimation of high chlorides during a purification step. Volatilization of the plutonium was accomplished with large volumes of the Cl_2–CCl_4 reagent, but its behavior was unpredictable, probably due to physical adsorption on the equipment of the small amounts of plutonium actually in process. The overall gamma decontamination factors were generally low, less than 40, and similar to those obtained by others. Such decontamination might be satisfactory for a close-coupled low decontamination process. Additional work is required to increase decontamination factors and to overcome some operational problems. (auth)

23705 (ORNL-TM-837) LABORATORY STUDY OF ZIRCONIUM–URANIUM PROCESSING EQUIPMENT CONTAMINATION AND DECONTAMINATION. F. E. Harrington, D. H. Newman, and B. Meservey (Oak Ridge National Lab., Tenn.). Apr. 29, 1964. Contract W-7405-eng-26. 16p.

Samples of 304 L and 347 stainless steel were exposed in STR (HNO_3–HF) and Modified Zirflex (NH_4F) dissolver solutions spiked with ^{95}Zr-Nb, ^{144}Ce-Pr, ^{106}Ru-Rh, and ^{137}Cs to determine which of these fission products deposited on the metal specimens. Similar metal samples were also contacted with spiked HNO_3 solution for comparison. The contaminated metal specimens were then decontaminated with nitric acid and oxalic acid-H_2O_2 or with ammonium oxalate ammonium citrate-H_2O_2 at 90 to 95°C. The contamination on both the exposed and decontaminated specimens was determined by gross gamma counting and gamma scanning. Exposure in STR, Modified Zirflex, and nitric acid solutions resulted in ^{106}Ru-Rh, ^{144}Ce-Pr, and ^{95}Zr-Nb contamination, respectively. The ^{144}Ce-Pr was easily removed by nitric acid, but the ^{106}Ru-Rh and ^{95}Zr-Nb were not. The ^{106}Ru-Rh was effectively removed in oxalic acid-H_2O_2. Decontamination of all 3 fission products in ammonium oxalate ammonium citrate-H_2O_2 was satisfactory. (auth)

23706 (RFP-349) AMERICIUM CAPABILITY AT ROCKY FLATS. A. K. Williams (Dow Chemical Co. Rocky Flats Div., Golden, Colo.). [nd]. Contract AT (29-1)-1106. 6p.

^{241}Am appears in Rocky Flats recovery streams as a decay product of ^{241}Pu. The americium is recovered only from a precipitation stream where it follows in the filtrate. The filtrate is concentrated by evaporation and most of the plutonium is separated by anion exchange. Capacity of the facility is 360 g per year. The plutonium recovery facility now under construction will include an americium processing line with a capacity of 3600 g per year on a 5-day 3-shift schedule, and 5000 g per year when the schedule is expanded to 7 days. This facility will use the same process. (M.C.G.)

23707 (TID-20609) ION EXCHANGE SEPARATION OF URANIUM AND THORIUM IN NON-AQUEOUS AND MIXED MEDIA. Progress Report, October 1963–April 1964. Johann Korkisch (Vienna. Universität). Contract IAEA 67/US. 53p.

Results are described of separating uranium and thorium from each other and various other metal ions as for instance from the rare earths and alkaline earths by means of anion exchange in nonaqueous and mixed solvents. Relations are described between the anion exchange behavior and the dielectric constants of the mixed organic solvents employed, for the purpose of predicting the adsorption characteristics of uranium, thorium, and the lanthanides. Results show that in several of these organic solvent media containing hydrochloric-, nitric-, or acetic acid as complexing agents for uranium and/or thorium, excellent and simple separations from other elements can be made. (auth)

23708 (UCRL-11182) SOME OBSERVATIONS ON LIQUID-LIQUID SETTLING. Wilbur F. Sweeney and Charles R. Wilke (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley). Jan. 20, 1964. Contract W-7405-eng-48. 76p.

The separation of water from Aroclor 1248 in a gravity settler was investigated with and without induced coalescence. The extent of mixing of the dispersion entering the settling chamber was determined by a light-intensity measuring device. At low flow rates and extents of mixing these two variables appeared to control the water concentration of the effluent Aroclor. However, at higher flow rates the water concentration of the effluent Aroclor was affected by many factors, including the flow rate, the extent of mixing, the dispersion zone present between the Aroclor and water phases, and the short circuiting of the Aroclor layer in the settling chamber. The short-circuiting effect was reduced by increasing the Aroclor layer's flow rate. The short circuiting is illustrated by drawings of the various Aroclor flow patterns produced by varying the operating conditions. A 1-inch-thick Fiberglas pad mounted in the settling chamber to induce coalescence effectively separated the two phases within the first foot of the settling chamber for all conditions investigated. (auth)

23709 (JPRS-24552(p.57-9)) THE SEPARATION AND ANALYSIS OF RARE EARTH ELEMENTS BY PAPER-PHASE PARTITION CHROMATOGRAPHY. III. TNOA–NH_4NO_3 SYSTEMS. Shu-mei Pang and Shu-chuan Liang. Translated from K'o Hsueh T'ung Pao, No. 2, 156(1964).

Separation of rare earths by paper-phase partition chromatography using tri-N-octa-amine–ammonium nitrate systems as the fluid phase is described. Separation efficiencies are discussed. (M.C.G.)

23710 DETERMINATION OF THE COEFFICIENTS OF DIFFUSION IN THE RESIN PHASE IN THE UO_2SO_4–ANION EXCHANGE RESIN SYSTEM. J. Estrada and L. G. Jodra (Junta de Energia Nuclear, Madrid). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. B, 59: 787-94(Dec. 1963). (In Spanish)

The uranium adsorption by anion exchange resin from sulfuric acid solutions was studied. The equilibrium was experimentally determined and the data can be correlated by an equation of the Freundlich's isotherm type. From the experimental results and using the proper diffusion equation, the diffusion coefficient for the resin phase could be calculated; the obtained value is independent of the solution concentration within the 0.5–1.0 g U_3O_8/range. The results agree with those given by others for similar systems. (auth)

23711 ON LEACHING URANIUM AND RADIUM FROM CLAYS. G. Kh. Efendiev and A. N. Nuriev. Azerb. Khim. Zh., No. 4, 103-7(1963). (In Russian)

Leaching of Ra and W from maikop deposit clays containing 1.4×10^{-2} and 1.0×10^{-9}% Ra and U, respectively, showed a good extraction of W by aqueous solutions containing $NaHCO_3$ or $CaCl_2$(0.5N). An increase of Na, Mg, or Ca chlorides inhibits the level of U extraction by precipitating it as $Ca_2[UO_2(CO_3)_3]$. However, an increase of the above salts enhances the extraction of radium. (R.V.J.)

23712 THE $La(NO_3)_3 - HNO_3 - H_2O - (C_4H_9O)_3PO$ EXTRACTION SYSTEM AT 25°. A. V. Nikolaev and A. A. Kolesnikov (Inst. of Inorganic Chemistry, Academy of Sciences, Siberia SSR). Dokl. Akad. Nauk SSSR, 154: 1395-7(Feb. 21, 1964). (In Russian)

The $La(NO_3)_3-HNO_3-H_2O-(C_4H_9O)_3PO$ system was characterized completely at 25°C. La was determined by complexometric titration, the H_2O in the organic phase by Fisher's reagent, and HNO_3 by titration with caustic. Densities were determined for the organic and aqueous phases. Distribution coefficients are given for $La(NO_3)_3$, HNO_3, and H_2O over the whole concentration range. The results are also presented graphically. Both La and HNO_3 were extracted by the organic phase in amounts dependent on the composition of the aqueous phase. The extraction of HNO_3 was greater than that of $La(NO_3)_3$. The extraction of La increased at high HNO_3 concentrations of 65 to 70 wt %. The distribution coefficient for La varied from 0.01 to 1.0. The distribution coefficient of HNO_3 varied from 0.45 to 3 and higher. Values of D_{H_2O} varied from 0.025 to 0.15 and higher. The minimum extraction of H_2O was observed at 20 wt % HNO_3. The H_2O content increased with a further increase in HNO_3 concentration. It was possible to determine the distribution coefficients of $La(NO_3)_3$, HNO_3, and H_2O over all concentration regions. (TTT)

23713 A THERMOCHEMICAL STUDY OF THE $UO_2(NO_3)_2-H_2O-$TBP SYSTEM. A. V. Nikolaev and Yu. A. Afanas'ev (Inst. of Inorganic Chemistry, Academy of Sciences, Siberia SSR). Dokl. Akad. Nauk SSSR, 155: 374-5(Mar. 11, 1964). (In Russian)

The extraction of uranyl nitrate by tributyl phosphate (TBP) is a result of the following reaction: $UO_2^{2+} + 2NO_3^- + 2TBP \rightleftharpoons UO_2(NO_3)_2 \cdot 2TBP$. The thermal effect of the extraction (H_e) was determined calorimetrically, and can be represented as follows: $H_e = H_{dil.} + H_c + H_{soln}$, where $H_{dil.}$ is the heat of dilution of the aqueous phase and H_{soln} is the heat of dissolution of the uranium solvate in excess TBP. H_c is the heat of formation of the $UO_2(NO_3)_2 \cdot 2TBP$ solvate; the value of H_c can be calculated on determining values of H_e, $H_{dil.}$, and H_{soln} in a separate series of experiments. The dissolution of uranyl nitrate in TBP is accompanied by the evolution of heat, the amount of which increases with increasing mole fraction of uranyl nitrate in the TBP solvent. The heat of dilution is also positive. The value of H_c or the heat of formation of the $UO_2(NO_3)_2 \cdot 2TBP$ solvate was found to be 6300 ± 380 cal/mole. This high thermal value indicated that the reaction between uranyl nitrate and TBP is chemical in nature. This thermal effect was not observed in H_2O–TBP system. (TTT)

23714 ON THE STUDY OF THE COSEPARATION OF THORIUM (UX_1) WITH CALCIUM OXALATE. B. C. Purkayastha and S. N. Bhattacharyya (Saha Inst. of Nuclear Physics, Calcutta). J. Indian Chem. Soc., 41: 69-73(Jan. 1964).

The uptake of thorium (UX_1) and yttrium by calcium oxalate was studied. It was found that similar to rare earths, thorium (UX_1) is also carried through mixed crystal formation by calcium oxalate dihydrate. The range of mixed crystal formation of europium, yttrium, and thorium (UX_1) as guest in this system was investigated. In the case of thorium (UX_1), an unstable guest component is carried through mixed crystal formation by calcium oxalate dihydrate. (auth)

23715 SEPARATION OF RARE EARTH ELEMENTS BY A PAPER CHROMATOGRAPHIC METHOD. Shû-wei Páng and Shu-quan Liang. Kexue Tongbao, No. 11, 46-7 (1962). (In Chinese)

Di-(2-ethylhexyl) orthophosphoric acid (HDEHP) yielded satisfactory results when used for the separation of the rare earths. The distribution ratios, K, of 2 adjacent lanthanides, $(K_{Z+1}/K_Z)_{avg} = r$, reached values up to 2.5. Strips of filter paper soaked with a solution of HDEHP in toluene were used as the immobile phase while an acid solution of Na_2SO_4 containing the lanthanides constituted the mobile phase. The spots were properly developed on the strips after a period of 6 hours. At a pH value of 2.75, all the K values approached zero. The following values were obtained at pH = 0.62: La, 0.95; Sm, 0.84; Tb, 0.25; Er, Y, 0.03; Ce, Pr, 0.92; Eu, 0.74; Dy, 0.10; Tm, Yb, Lu, Sc, 0.0; Nd, 0.90; Gd, 0.60; and Ho, 0.05. Ce and Pr and Er and Y cannot be separated at this pH value. The separation of Ce and Pr may be carried out at pH = 1.08, at which the following K values are obtained: Ce, 0.83; and Pr, 0.78. La and Sm may be separated at the pH range from 0.62 to 2. The concentration of Na_2SO_4 affects the distribution: as it increases from 0.01 to 1.0$\underline{M}$, the ratio changes from 0.52 to 0.94. An increased HDEHP concentration on the paper strip tends to lower the separation reaction because the rare earth ions are retained more strongly. Using 0.5$\underline{M}$ Na_2SO_4 at a pH ranging from 0.62 to 1, good separation of the La–Pr–Nd–Sm–Eu–Gd, Ce–Eu–Tb–Tm, La–Ce–Pr–Nd–Sm–Y, and Sm–Eu–Gd–UO^{2+} mixtures can be obtained. (TTT)

23716 THE EXTRACTION OF URANIUM SALTS AND MINERAL ACIDS BY ALIPHATIC SULPHOXIDES. III. THE EXTRACTION OF URANYL NITRATE AND URANYL CHLORIDE. Wincenty Korpak (Inst. of Nuclear Research, Polish Academy of Science, Warsaw). Nukleonika, 9: 1-10(1964).

A study was made on uranyl nitrate and uranyl chloride extraction by the aliphatic sulphoxide method. Since both acids differ, the hydrochloric being the stronger one, the extraction of each salt proceeds in a different manner. Extraction coefficients based on the same ionic strength and the same uranium concentration indicate that the nitrate is more easily extracted. This process is also weakly exothermal. The effects of temperature, complex formation, and a third phase formation were examined. The infrared spectrum of the $UO_2Cl_2 \cdot 2$(di-n-octyl sulphoxide) complex was analyzed, leading to the conclusion that uranium is bonded with oxygen and not with sulphur. (P.C.H.)

23717 SORPTION OF STRONTIUM IONS ON SODIUM MOLECULAR SCREEN. G. V. Tsitsishvili and A. Yu. Krupennikova. Radiokhimiya, 5: 656-60(1963). (In Russian)

New data are presented on ion-exchange properties of synthetic A type zeolite (sodium aluminosilicate) studied with ^{90}Sr as a radioactive tracer and verified by chemical methods. Properties of long-life fission fragments $^{90}Sr-^{90}Y$ were investigated. (R.V.J.)

23718 SEPARATION OF GOLD FROM CHLORIDE SOLUTIONS BY SORPTION ON CATIONS AND SEPARATION OF CARRIER-FREE GOLD. Fu-chiung Wang, Yu. V. Norseev, V. A. Khalkin, and Tao-nan Chao. Radiokhimiya, 5: 661-4(1963). (In Russian)

Adsorption of $AuCl_4^-$ on sulfocations from hydrochloric acid or chloride solutions in a simpler method of separating carrier-free ^{199}Au from neutron-irradiated platinum than the solvent extraction method because platinum cannot be sorbed by sulfocations. (R.V.J.)

23719 COMPLEXING OF AMERICIUM WITH ACIDIC PHOSPHORUS ORGANIC COMPOUNDS. V. I. Zemlyanukhin, G. P. Savoskina, and M. F. Pushlenkov. Radiokhimiya, 5: 674-9(1963). (In Russian)

Studies of the extraction of americium from various media by dibutyl phosphate (DBP) indicated that the extraction mechanism varies with increased acid concentration in aqueous solutions. At low acidity (to 1$\underline{M}$) of the solution americium displaces hydrogen in DBP forming $Am(HA_2)_3$ complexes with complexing constant K = 1.6 ± 0.3 for 30% solution of DBP in CCl_4. At high acid concentration, an addition reaction forms different complexes of the $Am(NO_3)_3 \cdot nH_2A_2$ type. A synergistic effect was discovered in the extraction of americium by TBP and DPP mixtures. (R.V.J.)

23720 MICROQUANTITIES OF ELEMENTS IN AQUEOUS SOLUTIONS. PROTACTINIUM CATION COMPLEXES. I. E. Starik and L. I. Il'menkova. Radiokhimiya, 5: 679-83(1963). (In Russian)

The effects of salt composition on ^{233}Pa behavior in aqueous solutions were analyzed. Protactinium extraction from 3$\underline{M}$ HNO_3 by 25% TBP in benzene is described by the following equation: $Pa(NO_3)_4^+ + NO_3^- + 2TBP \rightleftharpoons [Pa(NO_3)_5 \cdot 2TBP]_{org}$. The prevailing form of Pa in 3$\underline{M}$ HNO_3 is $[Pa(NO_3)_4]^+$. The behavior of Pa in HNO_3 (1 to 2$\underline{M}$) and identical content of H^+ and NO_3^- ions depends on the properties of the first group cations. Protactinium hydrolysis in HNO_3 (μ = 3$\underline{M}$) solution diminished according to the cation series $Li^+ < Na^+ < NH_4^+ < K^+ < Rb[H^+] = 1$ to 2$\underline{M}$. (R.V.J.)

23721 SEPARATION OF STRONTIUM FROM PREVAILING QUANTITIES OF CALCIUM BY MEANS OF ELECTROPHORETIC METHOD. V. P. Shvedov, A. V. Stepanov, and N. I. Gorskii. Radiokhimiya, 5: 690-4(1963). (In Russian)

An analysis was made of the electric migration rate of Ca and Sr in ethylenediaminetetraacetic acid solutions. The data were used for determining the instability constants for calcium and strontium complexes: $pK_{Ca} = 10.85 \pm 0.25$ and $pK_{Sr} = 8.63 \pm 0.19$. Optimum conditions were found for Ca and Sr separation in complexon(III) solutions. Separation of Ca and Sr mixtures with ratios 100:1, 2770:1, 5700:1, 27,200:1, and 100,000:1 was achieved. It is shown that a continuous electrophoretic method is efficient for the separation of mixtures similar in their chemical properties and found in high concentration ratios. (R.V.J.)

23722 CHROMATOGRAPHIC SEPARATION OF RARE EARTHS AND CERTAIN ACTINIDES ON CATIONITES IN THE PRESENCE OF RADIOACTIVE ISOTOPES, COPRECIPITATING WITH LaF_3. I. Brandshtetr, T. S. Zvarova, M. Krzhivanek, and Ya. Maly. Radiokhimiya, 5: 694-9(1963). (In Russian)

Gadolinium numbers for lanthanides and a series of actinides were determined during elution using lactate, α-hydroxyisobutyrate, and ammonium citrate on Dowex resin 50 × 12 and lactate elution on Cates C × 8 resin. It was found that gadolinium numbers do not exhibit identical characteristics for the same resins. The elution position of α-active elements which interfere with chromatographic separation of transuranic elements was determined. (R.V.J.)

23723 DISTRIBUTIVE CHROMATOGRAPHY ON PHOTOPLASTIC-4 SEPARATION OF EUROPIUM FROM RARE EARTHS. L. N. Moskvin. Radiokhimiya, 5: 747-9 (1963). (In Russian)

A method combining Johnson reducer with distributive chromatography was used for separation of Eu from other rare earths (even when there are only traces). (R.V.J.)

23724 THE PROBLEM OF THE ABSORPTION OF RADIOACTIVE ISOTOPES FROM AQUEOUS AND FROM WATER-ETHANOL SOLUTIONS. I. E. Starik, F. L. Ginzburg, and L. D. Sheidina. Radiokhimiya, 6: 19-26 (1964). (In Russian)

Although the determination of the adsorption of radioactive elements from nonaqueous solutions is rendered difficult by the absence of a single pH scale which prevents the direct comparison of data obtained in $H_2O-C_2H_5OH$ mixtures, it was found that up to an ethanol concentration of 80% and within the pH range from 2 to 8, the glass-electrode technique may be employed. The effect of various adsorbents, such as glass, fluorothene, Pt, Cu, Armco iron, Sn, Ni, Al, Au, and Ag was determined by a method involving the rotating of a small disc made of the material under study in the solution at a rate of 60 rpm for 2 hours. Comparison of the data obtained by varying the adsorbent, the pH, and the ethanol content, indicated that, in aqueous solutions, ^{241}Am and ^{233}Pa exhibit similar behavior and differ only in the position of the sorption maximum. Highly diluted solutions of Am and Pa, 10^{-9} and 10^{-13}M were used in the experiments. In the $H_2O-C_2H_5OH$ solution the elements had differing sorption properties, depending on the adsorbent and the pH of the solution. It appeared probable that in the case of Am the nonaqueous solvent changes the electrostatic effect of the solvate layer as a result of the decrease of the electrostatic penetrability. In the case of Pa, the solvation involved a specific interaction with the solvent, as the nature of the compound formed changed with the pH. Thus, the marked decrease in the sorption, observed at pH = 3.5, was probably due to the formation of neutral Pa complexes. (TTT)

23725 THE EXTRACTION PROPERTIES OF FERMIUM AND MENDELEVIUM (TBP-HNO_3 AND TBP-HCl). I. Brandshtettr, Wang Tung Seng, K. A. Gavrilov, E. Gvuzd', Ya Maly, and M. Taube. Radiokhimiya, 6: 26-35(1964). (In Russian)

The distribution chromatography method, developed by S. Siekierski and I. Fidelis (J. Chromatography, 4: 160 (1960); 5: 161(1961)) was used to examine the extraction behavior of Fm and Md in the TBP-HNO_3 and TBP-HCl systems; Cf was also studied under identical conditions in order to compare the data with previous static extraction studies. About 80 atoms of Md and Fm and about 107 atoms of ^{246}Cf were available for each individual experiment. The Md was determined by recording the fission fragments of its daughter ^{256}Fm, which undergoes spontaneous fission; for the determination of Fm, ^{256}Fm and ^{252}Fm isotopes were used. The extraction tests were carried out on silica gel in small glass columns with a free volume of 15 to 21 drops at an elution rate of 4 or 2 drops/min for HNO_3 and HCl, respectively. The separation factors were based on the separation from Eu. The following values were obtained: $D_{Cf}^{HNO_3}/D_{Eu}^{HNO_3} = 0.095 \pm 0.05$; for Fm 1 ± 0.05; and for Md 1.2 ± 0.05. The logarithm of the distribution coefficient, plotted as a function of the concentration was close to a straight line. Comparison of the results obtained in the TBP-HNO_3 and the TBP-HCl systems revealed that in chromatographic extraction the heavy actinides are better separated in HCl-containing solutions than in HNO_3-containing solutions. The heavy actinides behaved like their lanthanide analogs. In the case of HCl the actinides are shifted 2 and in the case of HNO_3 they are shifted 5 positions with respect to the lanthanides with a similar f shell. (TTT)

23726 SEPARATION OF NEPTUNIUM-239 FROM IRRADIATED URANIUM BY MEANS OF THE ION EXCHANGE METHOD. A. D. Gel'man, M. P. Mefod'eva, E. D. Kiseleva, M. P. Glazunov, P. N. Kodochigov, and V. F. Peretrukhin. Radiokhimiya, 6: 35-42(1964). (In Russian)

The separation of ^{239}Np from the solution formed by dissolution of an irradiated U target, containing fission fragments, in HNO_3 may be best achieved by means of ion-exchange chromatography. Ion exchange resins, anionite AV-17 and cationite KU-2 were used in the studies and the behavior of ^{239}Np and ^{106}Ru was examined. The experiments involved determination of adsorption under static conditions by shaking the HNO_3 solution containing ^{239}Np with the anion-exchange resin until equilibrium was reached; the distribution coefficient was determined by measuring the initial and equilibrium activities of the solution. The Np was reduced to its tetravalent form by heating it with hydrazine. After adsorption on the resin column, the Np was desorbed by 0.1M nitric acid. It was found that under the experimental conditions used, after a single passage through the column filled with the AV-17 resin, the ^{239}Np obtained was practically free from fission-product activity. For further purification, the material was also passed through the KU-2 cation exchange column. (TTT)

23727 THE ISOLATION OF CARRIER-FREE RADIOACTIVE CERIUM FROM A MIXTURE OF FISSION PRODUCTS. N. E. Brezhneva, V. I. Levin, G. V. Korpusov, N. M. Man'ko, and G. F. Plotnov. Radiokhimiya, 6: 66-72(1964). (In Russian)

This is part of the treatment scheme proposed at the Second Geneva Conference for the separation of the fission products into groups. The rare earths and strontium are concentrated by carrying on calcium oxalate (Ca = 2g/l). Cerium is separated from other rare earths, strontium, and trace impurities by solvent extraction in the tetravalent state from a nitric acid solution. Cerium is most suitably oxidized by means of ozone or by electrolysis. Ether, nitromethane, and tributylphosphate (TBP) can be used as extractants. Diethyl ether extracts 95 to 98% of the cerium from a 6 to 8N HNO_3 solution, but special precautions must be taken to remove peroxyether compounds, which slowly reduce Ce(IV) to Ce(III). Ozone must also be removed by blowing air or nitrogen through the solution in order to prevent the formation of peroxy-compounds with ether. Nitromethane does not react with tetravalent cerium or ozone. Hence, ozone can be used as a holding oxidant to prevent the reduction of Ce(IV) to Ce(III). A total of 60 to 80% of the cerium is extracted from 3 to 5N HNO_3. Since nitromethane extracts a number of other elements, countercurrent extraction must be used to obtain high decontamination. TBP extracts Ce in good yield over a wide range of acidities, but ozone reacts with TBP to give a product which slowly reduces Ce(IV) to Ce(III). Hence, ozone cannot be used as a holding oxidant with TBP. Cerium was back-extracted with a dilute peroxide solution. The best experimental results were obtained with the use of nitromethane as an extractant and ozone as the oxidizing agent. The overall recovery was 95 to 96%; the known loss was 0.05% and the radiochemical purity of the cerium product was 99.5%. ^{147}Pm and ^{90}Y were the main impurities. (TTT)

23728 THE EXTRACTION OF PROTACTINIUM, ZIRCONIUM AND NIOBIUM n-BENZOYLPHENYLHYDROXYLAMINES FROM A SULFURIC ACID SOLUTION. R. A. D'yachkova and Vikt. I. Spitsyn. Radiokhimiya, 6: 102-4 (1964). (In Russian)

The reagent n-benzoylphenylhydroxylamine (BPHA) was used to separate ^{231}Pa from the chemically similar elements Zr and Nb. The distribution coefficients of ^{233}Pa, ^{95}Nb, and ^{95}Zr in trace amounts were determined between a 0.2% BPHA chloroform solution, and an aqueous H_2SO_4 solution. The K_D of ^{95}Nb was >1000 at a H_2SO_4 concentration >3N. Zr and Pa were extracted at lower acidities, but the distribution coefficients were significantly smaller (maximum K_D for ^{95}Zr was 90 and that of ^{233}Pa was 7). It took at least 2 hours to attain equilibrium with a 0.2% BPHA chloroform solution. Hence, an agitation time of 6 hours was used in determining the distribution coefficient. The distribution coefficient as a function of H_2SO_4 acidity in the aqueous phase did not change significantly in form on increasing the concentration of Zr and Nb from trace amounts to 0.2 mg/ml. A plot of the distribution coefficient of protactinium (Pa) as a function of BPHA concentration in the chloroform gave a straight line, whose slope indicated that 4 molecules of BPHA are extracted with each molecule of protactinium. (TTT)

23729 THE SEPARATION OF THE ALKALI METALS BY ELECTROPHORESIS. I. THE SEPARATION OF RUBIDIUM AND CESIUM WITH AMMONIUM PARATUNGSTATE. V. P. Shvedov and G. F. Nichugovskii. Radiokhimiya, 6: 104-7(1964). (In Russian)

The electrophoretic ion mobilities of Cs and Rb in a solution of ammonium paratungstate were determined in a cell filled with quartz sand used as a proous packing medium. ^{86}Rb and ^{134}Cs were used as tracers. The optimum conditions for the separation of Rb and Cs were obtained in 1×10^{-3} to 5×10^{-3}M solutions of ammonium paratungstate. A sharp separation of Rb and Cs was shown with a 3.5×10^{-3}M solution of ammonium paratungstate, a separation time of 18 minutes, and a potential gradient of 19 volts/cm. Teh addition of NH_4Cl resulted in an increase of Cs and Rb ion mobilities. The addition of a strong electrolyte led to an increase in the ionic mobilities of Rb and Cs. The effect increased in the following order: $Li^+ < Na^+ < NH_4^+ < K^+ < Rb^+ < Cs^+ < H^+$. The difference in electromigration rates of Rb and Cs was due to the specific effect of the paratungstate ion. Freshly-prepared ammonium tungstate solutions obtained by neutralizing tungstic acid with ammonium hydroxide ($H_2WO_4 + 2NH_4OH \rightarrow (NH_4)_2WO_4 + 2H_2O$) did not show this effect, unless the solution was acidified, whereupon WO_4^{2-} was converted to a polymerized form having a large negative charge. The ionic mobilities of Rb and Cs decreased, but the difference in ion mobility between the two ions increased. (TTT)

23730 THE SEPARATION OF THE ALKALI METALS BY ELECTROPHORESIS. II. THE SEPARATION OF RUBIDIUM AND CESIUM IN A POTASSIUM FERROCYANIDE SOLUTION. V. P. Shvedov and G. F. Nichugovskii. Radiokhimiya, 6: 107-10(1964). (In Russian)

The mobilities of Rb and Cs were determined in an electrolytic cell in the presence of varying concentrations of potassium ferrocyanide. ^{86}Rb and ^{134}Cs were used as tracers. The absolute ionic mobilities decreased with increasing concentration of ferrocyanide ion, but the difference in ionic mobilities between Cs and Rb increased on increasing the ferrocyanide concentration from 2×10^{-3} to 14×10^{-3} g-ion/l of $[Fe(CN)_6]^{4-}$. Rb was completely separated from Cs in a solution containing 0.034M $K_4Fe(CN)_6$ + 0.052M KNO_3 within 30 minutes at a potential gradient of 8.5 volts/cm^2. The differences in ion mobilities of Cs and Rb under these conditions were about 7 to 10×10^{-5} cm^2/volt · sec. The main difference for the improvement in the separation of Rb and Cs was due to the difference in the degree of association of Rb and Cs with the ferrocyanide ion. Since adsorption played a minor role, the migration data could be used to calculate the association constants of Rb and Cs with the ferrocyanide ion. (TTT)

23731 PARTITION CHROMATOGRAPHY ON TEFLON (POLYTETRAFLUOROETHYLENE). THE ISOLATION OF TRACE AMOUNTS OF Se FROM A SrO TARGET IRRADIATED WITH FAST PROTONS. L. N. Moskvin. Radiokhimiya, 6: 110-11(1964). (In Russian)

Ordinary ion-exchange resins partially or completely reduce selenium to the metallic state on the column, and are unsatisfactory in the separation of selenium. Teflon particles were suspended in dibutyl ether, and were poured into a column used for micro separations (h = 100 mm and d = 2 mm). The column was rinsed with tributylphosphate (TBP), and then with 11N HCl saturated with Cl_2 in order to remove the excess TBP between the teflon particles. This column could be used for selenium separations because of the oxidizing rinse that was employed. In order to determine the yield of ^{72}Se in a SrO target irradiated with 660-Mev protons, the SrO target was dissolved in 6N HCl, and the ^{72}Se was carried by precipitating Te after adding $SnCl_2$ as a reducing agent. The Te and trace amounts of ^{72}Se were taken up in a minimum volume of 13N HCl saturated with Cl_2, and were passed through a teflon column saturated with TBP as described above. ^{72}As, daughter of ^{72}Se, was oxidized to the pentavalent state, and passed through the column without being absorbed. Te and ^{72}Se were retained by the column. The ^{72}Se was eluted from the column by 5N HCl saturated with Cl_2, and tellurium was eluted with 1N HCl. The ^{72}Se fraction was radiochemically pure. The separation from other elements was quantitative. (TTT)

23732 THE SEPARATION OF GOLD AND THALLIUM FROM A COMPLEX MIXTURE OF ELEMENTS BY MEANS OF PARTITION CHROMATOGRAPHY. B. K. Preobrazhenskii, A. V. Kalyamin, and I. Mikhalcha. Radiokhimiya, 6: 111-12(1964). (In Russian)

Gold and thallium were selectively extracted by a thin layer of diethyl ether retained on the surface of teflon particles. A complex mixture of other radioactivities obtained by irradiating bismuth with high-energy protons passed through the column without absorption because they showed low distribution coefficients in 2N HCl. It was found that gold could be selectively eluted from the column with 0.5N HCl. Thallium was then eluted with 0.2N HNO_3 or with ether. All aqueous eluting solutions had to be saturated with ether so that the ether layer was not removed from the surface of the teflon particles. The initial 2N HCl solution was saturated with gaseous Cl_2 in order to maintain thallium in the trivalent state. The gold concentration had to be $>10^{-4}$M in order to obtain fast equilibrium between the aqueous and organic phases. Thallium could be present in trace quantities. The separations were carried out on a column 80 mm long and 2 to 3 mm in diameter. Measurements of the γ spectra and half lives showed that the radioactive gold and thallium were radiochemically pure. Experiments with 8N HNO_3 were unsatisfactory because the strong nitric acid reacted with the ether film. (TTT)

23733 THE SEPARATION OF ARSENIC AND GERMANIUM PHENYL DERIVATIVES BY MEANS OF PAPER PARTITION CHROMATOGRAPHY. V. D. Nefedov, M. A. Toropova, I. V. Krivokhatskaya, and O. V. Kesarev. Radiokhimiya, 6: 112-13(1964). (In Russian)

When an arsenic compound such as $Ph_4{}^{71}AsX$ (here Ph stands for a phenyl group, and X = Cl^-, Br^-, or I^-) decays to a negative intermediate ion according to the following reaction: $Ph_4{}^{71}AsX \xrightarrow{\beta^+} [Ph_4{}^{71}GeX]^-$, the most probable germanium compounds that are finally formed are of the type Ph_4Ge and Ph_3GeX. The compounds Ph_4AsBr, Ph_4Ge, and Ph_3GeBr labeled with ^{14}C were synthesized, and were separated by paper chromatography. Mixtures of acetone-methanol-water (4 : 3 : 2), of pyridine-water (1 : 2), and ethylacetate alone were used as developing solvents. Each substance was characterized by a definite R_f value, which was not affected by the presence of other components. The R_f values were 0.85 to 0.88 for Ph_4AsBr with pyrine-water or the acetone-methanol-water mixture, zero for Ph_4Ge, and 0.67 to 0.71 for Ph_3GeBr. This separation scheme can be used to analyze for products formed as a result of the positron decay of ^{71}As in other phenyl derivatives of arsenic such as Ph_3As, Ph_3AsX_2, etc. (TTT)

23734 THE SEPARATION OF BARIUM AND STRONTIUM BY EXCHANGE BETWEEN AN AMALGAM AND A SOLUTION. B. P. Kiselev, V. L. Balashov, A. A. Kolchin, and V. V. Lebedev. Radiokhimiya, 6: 114-17(1964). (In Russian)

A screw agitator was used to mix about 40 ml of $0.3\underline{N}$ strontium amalgam with 40 ml of $0.4\underline{N}$ $BaCl_2$ solution in an exchange cell 100 ml in volume. Equilibrium was attained in 40 minutes. Because the separation coefficient for the amalgam exchange was so large, tracer ^{89}Sr was used to measure the distribution of strontium between the phases. Because of a 10% ^{90}Sr impurity in the ^{89}Sr tracer, the samples were counted 24 days later after equilibrium was established between ^{90}Sr and its ^{90}Y daughter. The separation coefficient for the amalgam exchange between the strontium amalgam and the aqueous barium chloride solution was found to be 1.7×10^4. The amount of Sr in the Ba fraction after amalgam exchange was about 10^{-2}% with the same amounts of Ba and Sr in the initial solution. Since the distribution coefficient does not depend on the relative amounts of Ba and Sr, a higher purification of Ba from Sr can be obtained with a smaller initial content of Sr in the solution. The amount of Sr in the Ba is determined by the completeness of separation of the aqueous solution from the mercury amalgam. The exchange rate was calculated to be 1-2 ka/m^2. (TTT)

23735 THE PROBLEM OF SEPARATING STRONTIUM-90 AND YTTRIUM-90 BY MEANS OF GELATIN FOAM. V. V. Pushkarev, V. F. Bagretsov, and V. D. Puzako. Radiokhimiya, 6: 120-1(1964). (In Russian)

A method was previously developed for separating radioactive isotopes by absorbing one of them on gelatin foam (Radiokhimiya, 3: 498(1961) No. 4). This method was used for the preparation of radiochemically pure solutions of ^{90}Sr and ^{90}Y from solutions containing these isotopes in radiochemical equilibrium. The solution of the chlorides of these salts, with an activity between 0.1 and 1.0 mC/liter, contaminated with alkaline-earth salts, was heated to 85 to 95°C and a 1% gelatin solution, a $1\underline{N}$ solution of $FeCl_3$ and NaOH was added until pH = 6 was reached. Air was bubbled through the solution; the foam formed carried the FeOH and was collected in a separate container. More than 99% of the ^{90}Y but less than 20% of the ^{90}Sr was absorbed on the Fe hydroxide. The clarified solution may be used as radiochemically pure ^{90}Sr. In order to obtain a similar ^{90}Y solution, BaCl, gelatin, and Na_2SO_4 solutions were added successively to the original mixture, adjusting the pH to zero. After bubbling air through the mixture, more than 90% of the Sr, isomorphically bound to the $BaSO_4$, was adsorbed by the gelatin foam and could be thus removed from the solution. After repeated operations, the remaining solution could be considered as a radiochemically pure one. The operation required less than 30 minutes. (TTT)

23736 CERTAIN PROPERTIES OF SULFOSTYRENE CATION EXCHANGE RESINS AND THEIR ACTION IN THE NEUTRAL AND WEAKLY ACID RANGE. B. K. Preobrazhenskii and O. M. Lilova. Radiokhimiya, 6: 128-30 (1964). (In Russian)

During examination of sulfostyrene cation-exchange resins, it was found that under certain conditions they exhibit specific sorption. Resins containing about 6 to 7% divinyl benzene were found to change their properties drastically upon storage in wet air and become spoiled after a few months, exhibiting irregular behavior. This may be due to the oxidation of the organic matrix of the resin, resulting in the formation of COOH and OH groups, which possess specific adsorptive properties with respect to certain ions. This unsatisfactory behavior of the resin may be attributed to impure raw materials used during its fabrication. Therefore, if the resins are to be used in the neutral or the weakly acid ranges where this behavior is noted, it should be analyzed for complex-forming groups. It was also noted that resins with limited cross linkage are more subject to oxidation. Therefore, in order to obtain a satisfactorily stable resin, the divinyl benzene component must be replaced by a compound with a longer chain and the compound used as raw materials must be free from oxidized groups; subsequent oxidation of the material must be prevented. Steps should be taken also to ensure the uniform distribution of cross linkages throughout the polymeric chain. (TTT)

23737 IMPROVEMENTS IN OR RELATING TO THE SEPARATION OF AT LEAST ONE CONSTITUENT FROM A GASEOUS MIXTURE. Claude Fabre and Jean-Claude Martin (to Commissariat à l'Energie Atomique). British Patent 956,278. Apr. 22, 1964. Priority date Aug. 14, 1959, France.

An apparatus and process for the continuous separation of one or more constituents of a gaseous mixture are patented. The invention is particularly applicable to the purification of uranium hexafluoride. The initial gaseous current is cooled, causing the formation of crystals of the constituents to be separated. The crystals are contacted with a hot surface, causing at least partial sublimation. The constituents formed during the sublimation are then recovered. The crystals may be separated from the gaseous current by cyclone centrifugation, and the gas may be recycled. (M.P.G.)

23738 METHOD FOR THE PREPARATION OF URANYL NITRATE OF NUCLEAR PURITY. Ludwig Ziehl. German Patent 1,162,819. Feb. 13, 1964. Filed Aug. 20, 1962.

Uranyl nitrate is prepared by the extraction of impure watery solutions of uranyl nitrate with organic extraction agents. The extraction is directly carried out with uranyl nitrate solutions that are obtained from ionic exchangers by elution. A 25% solution of tributyl phosphate in inert hydrocarbons, e.g. petroleum, is used as extraction agent. The uranium extraction is substantially quantitative and the impurities remain entirely in the watery phase. The sulfate content has no noticeable effect on the yield of uranium. (Gmelin Inst.)

23739 SEPARATION BY LIQUID-LIQUID EXTRACTION. James M. Norwood, Jr. and Edward V. Sherry, Jr. (to Pittsburgh Plate Glass Co.). U. S. Patent 3,133,794. May 19, 1964. Filed June 19, 1959.

A method is described for operating an extraction column for the separation of Zr from Hf by the selective countercurrent extraction of Zr into an organic phase, while leaving the Hf in an aqueous phase. The method provides high Zr purity and yield. (D.C.W.)

ENGINEERING

General

23740 (NP-13899) SERT-I FLIGHT TEST PROGRAM, ION ROCKET ENGINE DEVELOPMENT, AND ION ENGINE SUPPORTING RESEARCH AND EVALUATION. Quarterly Progress Report No. 1, October 14, 1963–January 13, 1964. (Hughes Aircraft Co. Hughes Research Labs., Malibu, Calif.). Feb. 28, 1964. Contracts NAS-3-4108, NAS-3-4109, and NAS-3-4110. 155p.

The development of materials for use in a Cs-ion propulsion engine for space vehicles is reported. The status of SERT-I flight test activities is summarized. (T.F.H.)

23741 (TID-7690(p.102-5)) A RECENT SURVEY OF THE APPLICATION OF CODES TO THE DESIGN OF BLOWER CASINGS. R. W. Schneider (Oak Ridge National Lab., Tenn.).

The present ASME code status of blower casings is discussed. Differences between requirements in existing ASME codes and in the pending "ASME Boiler and Pressure Vessel Code, Section III, Rules for Construction of Nuclear Vessels" are described and tabulated. (M.J.T.)

23742 (TID-7690(p.106-20)) DRY FRICTION IN GAS BEARINGS AND SHAFT SEALS. H. W. Fricker (Oak Ridge National Lab., Tenn.).

The successful operation of shaft seals for gases and gas bearings depends largely on the rubbing properties of the materials used. For gas bearings, where contacts of the moving surfaces occur only during starting and stopping, freedom from seizure is the most important requirement. In a continually rubbing shaft seal low wear and friction are also very important. These three properties do not always go hand in hand, although good rubbing pairs possess all of them to a certain degree. The results of tests carried out within the Dragon Project on the frictional properties of various materials are discussed in the light of their importance for shaft seals and gas bearings. (auth)

23743 (TID-7690(p.121-42)) COMPARISON OF SEAL SYSTEMS FOR GAS-COOLED REACTOR MACHINERY. William K. Stair (Tennessee. Univ., Knoxville).

A partially completed study of systems concepts, initiated in an effort to recognize that the seal system involves more than simple seal elements and to identify the problems needing investigation, is described. The bushing, labyrinth, visco, and mechanical seals are considered, for certain specific reactor characteristics and operating conditions. (M.J.T.)

23744 (TID-7690(p.219-35)) EXPERIENCE OF SOCIETE RATEAU IN THE CONSTRUCTION AND OPERATION OF GAS-BEARING COMPRESSORS. Jacques P. Chaboseau and Christain Mech (Société Rateau, La Courneuve, France).

Engineering work on journal and thrust-bearings is outlined. The reliability of hydrodynamic gas-bearings of the tilting pad type was demonstrated. General specifications of a typical gas circulator are given. Machines already built, under construction, or under design are briefly surveyed. The main engineering problems encountered in the construction of the gas-bearing machines—problems with electric motors, impellers, pressure casings, and electrical seal connections—are mentioned. (M.J.T.)

23745 (TID-7690(p.236-44)) DEVELOPMENT OF A HIGH-TEMPERATURE HELIUM COMPRESSOR. H. Schwarz (Mechanical Technology Inc., Latham, N. Y.), and J. P. McGee (Bureau of Mines. Morgantown [Coal] Research Center, W. Va.).

A description is given of the compressor design. The instrumentation and operational procedure are discussed and the final aerodynamic test results presented. Problem areas and future trends are outlined. (auth)

23746 (TID-7690(p.263-72)) DEVELOPMENT OF PROSPECTS FOR MULTI-PAD GAS-BEARINGS. Jacques P. Chaboseau and Christian Mech (Societe Rateau, La Courneuve, France).

The performance of gas bearings was explored. The range of bearing characteristics covered by the results is given. Tests on materials are being continued with a view to enlarging the range of gas-bearing applications. Future possibilities for industrial applications are discussed. (M.J.T.)

23747 (TID-7690(p.273-302)) AN INVESTIGATION OF PRESSURE DISTRIBUTION IN GAS-LUBRICATED, TILTING-PAD, JOURNAL BEARINGS FOR HIGH-SPEED ROTORS. E. J. Gunter, Jr., J. G. Hinkle, and D. D. Fuller (Franklin Inst. Labs. for Research and Development, Philadelphia)

The pivoted-pad, self-acting, gas-lubricated bearing, with hydrostatic augment for starting and stopping, shows considerable promise for high-speed turbo-rotor applications, because of its antiwhirl characteristic stability, its ability to compensate for misalignment, and its good load carrying capacity. A computer program developed for partial journal bearings was used for the analysis of the tilting-pad journal bearing. The effects of speed, load, and film thickness on pressure distribution are considered. The experimental apparatus is described. The Reynolds equation, bearing pressure distribution, compressibility effects, and pivot pressure are considered theoretically. Experimental and theoretical performance characteristics are correlated for pivot pressure without preload and with preload exerted by the foil bearing or by the top shoe. (M.J.T.)

23748 (TID-7690(p.303-12)) TESTS USING HYDROSTATIC GAS BEARINGS. D. L. Gray (Oak Ridge National Lab., Tenn.).

A hydrostatic gas-bearing experiment is described. Unbalance, bearing stiffness, critical revolution speed, and flow requirements are tested. (M.J.T.)

23749 (TID-7690(p.313-30)) THE STABILITY OF A FLEXIBLE ROTOR SUBJECTED TO ROTARY DAMPING. Edgar J. Gunter, Jr. (Franklin Inst. Labs. for Research and Development, Philadelphia).

Observations of precession or shaft whirling above the first critical speed in rotors are described. This shaft whirling is caused by a frictional force—rotary damping. The equations of motion of the rotor system are derived, considering deflection, bearing forces, and shaft characteristics. Analysis leads to a stability criterion for a flexible rotor subjected to rotary damping. A stability threshold is found. The rotor precession speed is constant, independent of the rotational speed. Stability is found independent of the degree of rotor balance. Effects of bearing-housing flexibility on rotor stability are considered. (M.J.T.)

23750 TONKIE PLENKI V TEKHNIKE SVERKHVYSOKIKH CHASTOT. (Thin Films in Super-High Frequency Engineering). V. V. Slutskaya. Moscow, Gosenergoizdat, 1962. 398p.

Systematic data are given of the physics, technology, and preparation of thin metallic and non-metallic foils used in super high-frequency techniques. Construction and properties of various thin film elements (bolometers, thermocouples, absorbers, etc) are described. (R.V.J.)

Applications of Nuclear Explosions

23751 (UCRL-7350) CHARACTERISTIC EFFECTS OF CONTAINED NUCLEAR EXPLOSIONS FOR EVALUATION OF MINING APPLICATIONS. Charles R. Boardman, David D. Rabb, and Richard D. McArthur (California. Univ., Livermore. Lawrence Radiation Lab.). May 3, 1963. Contract W-7405-eng-48. 50p.

Underground nuclear tests in tuff, alluvium, salt, and granite yielded data essential to the evaluation of mining applications of contained nuclear detonations. The data indicated that for these media the cavity radius is predictable within ±20% without regard to the properties of the rock in the immediate shot environment. Properties of the chimney of broken rock resulting from collapse of the cavity, on the other hand, were found to be related to the properties of the rock and its preshot structural weaknesses. Seismic effects and radioactivity distribution were sufficiently documented to serve as a basis for predicting the safety conditions associated with detonations for a variety of yields. (auth)

23752 (UCRL-7793) CRATERING EXPERIENCE WITH CHEMICAL AND NUCLEAR EXPLOSIVES. Milo D. Nordyke (California. Univ., Livermore. Lawrence Radiation Lab.). [1963]. Contract W-7405-eng-48. 38p. (CONF-470-8)

From 3rd Plowshare Symposium on Engineering with Nuclear Explosives, Davis, Calif., Apr. 1964.

Over the past 13 years, a considerable body of data on explosive cratering was developed, which is applicable to nuclear excavation projects. These data were obtained from more than ten cratering programs using chemical explosives (TNT or nitromethane) and seven nuclear cratering detonations. The types of media studied ranged from marine muck to hard, dry basalt, although most effort was devoted to craters in NTS (Nevada Test Site) desert alluvium and basalt. These data led to the development of depth-of-burst curves that relate crater dimensions to the depth of burst and the yield of the explosive. Comparison of these depth-of-burst curves with similar data by Russian investigators revealed some marked discrepancies. Considerable effort was also devoted to the study with chemical explosives of the use of linear explosives and rows of point charges. On the basis of these studies it was generally concluded that the use of a row of point charges spaced a distance apart equal to about one single crater radius will result in: a smooth-sided ditch with a width and depth approximately equal to a single crater diameter and depth, lips on the sides of the ditch that are about twice the single crater lip height, and a lip on the end that is one-fourth or less than the lip height on the sides of the ditch. All row charge data to date are in desert alluvium. Plans are being made to conduct a row charge experiment in basalt with five 20-ton chemical-explosive charges (nitromethane). (auth)

Facilities and Equipment

Refer also to abstracts 24309 and 24754.

23753 (AERE-R-4085) THE SHIELDING AND SEALING OF A MASTER-SLAVE NO. 7 MANIPULATOR. W. K. Curtis (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1964. 23p.

Description is given of a development by which a model 7 (over the wall type) Master Slave Manipulator may be adapted for working a fully shielded cell, the latter being fitted with a gas tight container. Included are performance figures and maintenance data for the system. (auth)

23754 (NASA-CR-51) RESEARCH AND DEVELOPMENT OF PROPELLANT FEED SYSTEMS FOR ION ENGINES. Patrick J. Lawlor and Keith M. Montgomery (Thompson Ramo Wooldridge Inc., Cleveland). May 1964. Contract NAS-8-2525. 116p.

The propellant feed system component designs are discussed. The fuel system requirements and fuel feed methods are outlined. The system components including the control valve, pressure transducer, storage and expulsion components, the servo system, and the condensing calorimeter are discussed. Data from the operational testing of the system are presented. (C.E.S.)

23755 (UCRL-11157) LONGITUDINAL DISPERSION IN PROCESS EQUIPMENT. Thoeodore Vermeulen (California. Univ., Berkeley. Lawrence Radiation Lab.). Dec. 1963. Contract W-7405-eng-48. 32p. (CONF-527-1)

From Institute of Chemical Engineers Spring Meeting of Institutions, Midland Section, Birmingham, Eng., Mar. 1964.

The effects of longitudinal dispersion upon equipment performance can be calculated by several available methods, among them the diffusion model discussed. Countercurrent systems and packed-bed operations are described. Different types of dispersion are shown to occur in the laminar and turbulent flow regimes. The need for additional experimental work and for correlations of existing performance data after correction for longitudinal dispersion is shown. (auth)

23756 MEASUREMENT OF SHORT LIFETIMES OF CURRENT CARRIERS IN SEMICONDUCTOR DEVICES BY THE PULSE METHOD. A. I. Ilenkov and Yu. A. Tkhorik (Inst. of Automatic Electrometry, Novosibirsk, USSR and Inst. for Semiconductors, Kiev). Ukr. Fiz. Zh., 9: 139-49(Feb. 1964). (In Ukrainian)

The effective lifetime of current carriers in the base region of semiconductor diodes and transistors is an important parameter which determines the frequency and pulse properties. In this connection many methods of determination of this parameter were developed, as methods founded on the use of a-c signal (the measurement of cutoff frequency, measurements on an a-c bridge, the phase method), pulse methods (investigation of postinjection emf, investigation of direct transient characteristics, the method of double pulses, investigation of the transient switching responses of diodes), the method founded on the illumination of the device with γ rays. The most convenient and widespread method of lifetime measurement in semiconductor diodes is the determination of τ_e by the duration of the phase of constant reverse current with the diode switched from a forward to a reverse direction. It is shown that on determining τ_e by the switching transient characteristics it is necessary to take into account the form and the duration of the shape of the influence pulse when this duration is comparable with τ_e. An expression is obtained in operator form for determination of τ_e by the duration of the phase of constant reverse current with an arbitrary shape of the pulse. The errors in determination of τ_e due to neglecting the shape of the pulse are calculated; recommendations are given as to the choice of a procedure of measurement involving minimum errors. It is shown experimentally that neglecting the pulse shape leads to diminished values of τ_e. (auth)

23757 DISTRIBUTION UNIT FOR RADIOACTIVE SOLUTIONS, PARTICULARLY SOLUTIONS EMITTING GAMMA RAYS. (to Commissariat a l'Energie Atomique). British Patent 957,306. May 6, 1964. Priority date Nov. 26, 1959, France.

A distribution unit for dividing radioactive solutions into smaller volumes and bottling the smaller amounts is patented. The unit consists of several compartments within a protective enclosure, equipment within the compartments necessary for carrying out the various operations, and a transport device to route receptacles through the compartments. Operation of the equipment, transport device, and doors to the compartments is controlled from outside of the protective enclosure. The compartments are ventilated and maintained at a pressure slightly below atmospheric pressure, except for the final compartment where the radioactivity of the bottled solutions is verified and the bottles are placed in lead containers. (M.P.G.)

23758 ELECTRON BEAM FURNACE. Andrew O. DuBois, Howard R. Harker, and Charles W. Hanks (to Stauffer Chemical Co.). U. S. Patent 3,132,198. May 5, 1964. Filed Jan. 15, 1962.

An electron beam furnace in which the beam sources are isolated from materials being melted in order to minimize the risk of gases that are released and ionized during melting being attracted to the beam sources to establish a short circuiting flow of electrons is described. (C.E.S.)

23759 APPARATUS UTILIZING LIQUID METAL COOLANT FOR TRANSPORTING THERMALLY HOT INTENSELY RADIOACTIVE MATERIAL. John W. Allen (to Stanray Corp.). U. S. Patent 3,133,197. May 12, 1964. Filed June 16, 1960.

An apparatus for transporting spent reactor fuel elements or other radioactive material, is designed which provides both efficient heat conduction and efficient radiation shielding. The apparatus comprises a pressure retaining cask, a quantity of low melting metal, and means for transferring the molten metal into and out of the cask. The metal is preferably a bismuth–lead alloy, and the apparatus is mounted on a specially fitted railroad car. (D.L.C.)

Heat Transfer and Fluid Flow

23760 (ACNP-64022) INVESTIGATION OF VAPOR VOLUME FRACTION AND SLIP VELOCITY UNDER THE EURATOM PROGRAM. Quarterly Progress Report, January 1, 1964–March 31, 1964. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Apr. 20, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(11-1)-1272. 32p. (EURAEC-1045)

The range of flow parameters investigated was extended to include zero superficial liquid velocity runs and also the first runs at 1500 psi system pressure. Initial attempts at correlating the average void fraction data indicated that both superficial velocities and the ratio of actual to homogeneous voids (K) show promise of correlating the data. The superficial velocity technique has the advantage of being applicable to the zero liquid velocity case. The data were also reduced to slip ratios and compared to the Argonne correlation. The void profile data were improved by corrections to the reference traverse data. The new profile data at zero liquid velocity and 1500 psi are quite similar to the previously reported profile data. (auth)

23761 (AEEW-R-180) AN ANALYTICAL AND EXPERIMENTAL STUDY OF POOL BOILING WITH PARTICULAR REFERENCE TO ADDITIVES (thesis). W. L. Owens, Jr. (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). May 1963. 177p.

An experimental investigation of nucleate boiling heat transfer and critical heat flux is presented for water and various aqueous solutions boiling from horizontal stainless steel tubes and flat strips at atmospheric pressure. An integral method solution for film boiling is given and compared with existing experimental data. Analytical solutions were obtained for the temperature profiles with periodic internal heating of a flat plate and a cylinder. (auth)

23762 (AERE-R-4623) THE USE OF A PUMP TO REDUCE MIXING LENGTH IN THE DILUTION METHOD OF FLOW MEASUREMENT. C. G. Clayton (United Kingdom Atomic Energy Authority. Research Group. Wantage Research Lab., Wantage, Berks, England). May 1964. 16p.

In the dilution method of flow measurement samples should be removed at a point downstream beyond that at which the tracer is uniformly mixed over the cross section of the fluid. This condition often imposes a practical restriction to the application of the method when suitably long lengths of conduit are not available. If a pump can be included in the measuring section it may be used to reduce the mixing distance. An experiment was carried out to determine the mixing efficiency of a mixed-flow pump. Results obtained show that with either a four position or single orifice injection system the mixing introduced by the pump is almost complete. It was concluded that from the point of view of operating the dilution method in this system, an additional straight section of pipe does not appear to be necessary. Advantages are gained from restricting the test section to the main circulation pump, especially in cold water systems in power stations. (auth)

23763 (ANL-6654) A METHOD OF CALCULATING TRANSIENT TEMPERATURES IN A MULTIREGION, AXISYMMETRIC, CYLINDRICAL CONFIGURATION. THE ARGUS PROGRAM, 1089/RE248, WRITTEN IN FORTRAN II. D. F. Schoeberle, J. Heestand, and L. B. Miller (Argonne National Lab., Ill.). Nov. 1963. Contract W-31-109-eng-38. 119p.

A detailed description is given of ARGUS, a FORTRAN II computer program for calculating transient temperatures in any concentric cylindrical configuration. Included are an explanation of the mathematical methods, a discussion of special features and restrictions, input and output descriptions, operating instructions, several sample problems, and the code listing. The program allows up to 25 concentric regions, each containing either a stationary or turbulently flowing material with temperature-dependent properties. Any stationary material can have spatial- and time-dependent heat generation. Temperatures are calculated at node points which are equally spaced within a region. The number of radial node points in a stationary material region is specified by input. Up to 100 node points per radial row and up to 16 radial rows are allowed. Material properties of flowing materials are approximated by second-order polynomials, and the thermal properties of stationary materials are considered to be constant within a temperature phase. There may be up to 9 phase changes in stationary materials, with heats of transformation added to the material at the transformation temperatures. Thermal resistances at stationary region interfaces are considered by means of input coefficients of heat transfer. Film coefficients on flowing region boundaries are calculated by the program, and time-dependent coolant velocities are permitted. (auth)

23764 (APEX-724) HEAT TRANSFER CHARACTERISTICS OF CROSSED ROD MATRICES AT ELEVATED TEMPERATURES. Lynn Hardy and Robert N. Noyes (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). June 1961. Contracts AT(11-1)-171 and AF33(300)-38062. 60p.

Heat transfer coefficients, temperature perturbations, and friction factors, as determined from experiments on a particular design of an electrically heated wire screen matrix, were determined with and without dust injected in the cooling air and air blockages installed immediately upstream of the screen. Tests were conducted at temperature levels up to 2000°F and at power levels up to about 9 kw/in.^{3} of wire screen volume. Results indicated that the simulated moderator blocks caused temperature perturbations up to approximately 125°F at the power and temperature conditions tested. Heat transfer coefficients were up to 17% less than those reported previously, and were not affected appreciably by the injection of 3.3 grams of dust or with the installation of the air blockage. Friction factors were from 40% to 110% greater than those reported previously. (auth)

23765 (EUR-1631.d) EICHUNG MAGNETISCHER DURCHFLUSSMESSER FÜR FLÜSSIGMETALLE. (Calibration Loop of High Precision for Magnetic Flowmeter). B. Schelten-Peterssen and W. Schulze (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). 1964. 38p.

A calibration loop of high precision for magnetic flowmeters is described. Medium errors are less than 1%. A theoretical method to calculate the mass flow and all results obtained using this loop are described. (auth)

23766 (GEAP-4431) TWO-PHASE PRESSURE LOSSES. Quarterly Progress Report No. 7, August 22, 1963–November 11, 1963. E. Janssen and J. A. Kervinen (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Dec. 2, 1963. Contract AT(04-3)-189. 18p.

Pressure drop was measured along an annular channel with dimensions $D_1 = 0.375$ inch; $D_2 = 0.875$ inch; $L = 70$ inches. Flow was vertical and upward, and only the internal surface was heated. Subcooled conditions existed at the inlet, with two-phase conditions at the exit. Groups of three radial spacer pins on 18-inch centers along the channel, held the inner surface concentric with the outer surface. The single phase loss coefficient for each spacer group is $K_s = 0.21$. The single phase friction factor for the annular channel is given. The two-phase pressure drop increases as the quality increases for flow rates (G) of $(G/10^6) = 1.68$ and 1.0 lb/hr ft^2, but decreases as the quality increases (up to qualities of 21 percent) for $(G/10^6) = 0.5$ lb/hr ft^2. The effect of heat flux on the pressure drop is very slight over the range of fluxes tested. The two-phase pressure drop gradient, in the same annulus with no heat addition, is qualitatively the same as for a $\frac{1}{4}$-inch by $1\frac{3}{4}$ inches rectangular channel, but is quantitatively greater than for the rectangular channel. (auth)

23767 (KAPL-M-6149) STABILITY ANALYSIS PROGRAM FOR THE PREDICTION OF HYDRODYNAMIC FLOW OSCILLATIONS (SAP). David A. Feingold and J. N. Champlin (Knolls Atomic Power Lab., Schenectady, N. Y.). Apr. 15, 1964. Contract W-31-109-eng-52. 31p.

The SAP digital program determines the relative hydrodynamic stability of a heated channel. The program solves the thermal and hydraulic conservation equations by means of a linear frequency analysis. It has several features which facilitate its use for parameter studies and investigations to determine the effects of a number of variables on hydraulic stability. Machine time per problem is approximately 5 sec. The equations are presented, together with a sample problem, instructions, flow chart, and input description. (auth)

23768 (MIT-2995-1) HEAT TRANSFER DURING FILM CONDENSATION OF A LIQUID METAL VAPOR. Technical Report No. 9167-27. Suhas P. Sukhatme and Warren M. Rohsenow (Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering). Apr. 1964. Contract AT(30-1)-2995. 71p.

Investigations were made to resolve the discrepancy between theory and experiment for the case of heat transfer during film condensation of liquid metal vapors. Experiments by previous investigators yielded data, which are extremely scattered and markedly below the predictions of both the classical Nusselt theory and more recent modifications to it. All theoretical treatments so far have only taken account of the thermal resistance presented by the condensed film. However, calculations from kinetic theory showed that with liquid metals a significant thermal resistance can exist at the liquid-vapor interface. This resistance increased with decreasing vapor pressure and was dependent on the value of the "condensation coefficient." Experimental work to back up this hypothesis of a liquid-vapor interfacial resistance is presented. The working fluid for the experiments was mercury condensing at low pressures in the absence of non-condensable gases on a vertical nickel surface. Data of previous investigators were analyzed. (auth)

23769 (TID-19075) A THEORETICAL EXPERIMENT IN SUBCOOLED NUCLEATE BOILING. D. E. Dougherty (Knolls Atomic Power Lab., Schenectady, N. Y.). [1962]. Contract [W-31-109-eng-52]. 14p.

A phenomenological equation was developed to describe the static and dynamic vapor fractions in a boiling coolant channel. The analytic development concentrates upon the subcooled nucleate boiling regime. The parameters of this equation include a vapor generation rate and a condensation rate. Approximations for the functional dependencies of these parameters were obtained from an analysis of the microstructure of the subcooled boiling process and the integral equation which precisely defines the time and space dependent vapor fractions in a one dimensional flow field. (auth)

23770 (TID-20604) PROGRESS REPORT ON THE MODEL SODIUM-HEATED STEAM GENERATOR. Research Report No. 5452. D. W. Koch (Babcock and Wilcox Co. Research Center, Alliance, Ohio). Mar. 6, 1964. Contract AT(11-1)-1280. 20p.

A model sodium-heated steam generator has been designed to investigate the effects of carbon transfer on a system containing both ferritic and austenitic alloys. The model steam generator simulates a 1000 Mwe sodium-heated steam generator. This test program was developed to provide confidence in the selection of materials of construction for the 100 Mwe unit. The test apparatus has been designed and is described in detail. All loop components have been fabricated and the loop systems completed. (auth)

23771 (UCRL-6776) TWO-DIMENSIONAL LAGRANGIAN HYDRODYNAMIC DIFFERENCE EQUATIONS. William D. Schulz (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 17, 1963. Contract W-7405-eng-48. 65p.

A numerical model of a fluid is constructed by adding a tensor artificial viscosity to the hydrodynamic differential equations, which are then differenced to produce a set of equations suitable for solving on a digital computer. The equations apply to a system of two space coordinates and one time coordinate. The space coordinates can be either Cartesian or cylindrical. (auth)

23772 (UCRL-7530) PROCEDURES FOR DIGITAL COMPUTER ANALYSIS OF ONE-DIMENSIONAL FLUID FLOW PROCESSES INVOLVING REAL GASES. Michael D. Mintz and Duane P. Jordan (California. Univ., Livermore. Lawrence Radiation Lab.). Jan. 15, 1964. Contract W-7405-eng-48. 49p.

A discussion is presented regarding the use of real gas property data (data characterized by temperature and pressure dependence) in the analysis of one-dimensional, compressible, fluid flow problems. In particular, methods are suggested for the mathematical treatment of several commonly encountered processes, including isentropic flow, the generalized flow process (of which the Rayleigh and Fanno lines are special cases), and sub- and super-sonic flow through real nozzles. The philosophy of calculation is graphically demonstrated by means of simple logic flow diagrams. Special emphasis is placed upon the use and interpretation of tabular gas property data. A unique interpolation scheme is presented that preserves the continuity of both data and first derivatives. Applications of the described procedures are appended in the form of appropriate FORTRAN II digital computer code listings. (auth)

23773 STEADY MAGNETOHYDRODYNAMIC FLOW THROUGH A CHANNEL OF CIRCULAR SECTION. Frank Fishman (Avco Corp., Everett, Mass.). Advan. Energy Conversion, 4: 1-14(Jan.-Mar. 1964).

The electrical effects of a magnetohydrodynamic flow through a channel of circular section with electrodes are investigated theoretically. Attention is restricted to channels many diameters long; therefore, it is assumed that the flow velocity is uniform and parallel to the channel axis and the magnetic field is the applied field, taken to be uniform and normal to the channel axis. The current density is computed for this flow and is used to calculate the net current flowing between the electrodes and the electrical potential between them. The open-circuit voltage and internal impedance of the equivalent Thevenin circuit are computed; the non-dimensional form of these quantities depends only on the angular width of the electrodes. The power expended by the fluid in diffusing through the magnetic field and the Joule dissipation in the flow are calculated. The Joule dissipation is greater than the dissipation calculated from the net electrode current and the Thevenin internal resistance because of the presence of eddy currents within the fluid. These arise because the curved electrodes short out part of the induced emf. The effects of these eddy currents may be represented, at least approximately, by a resistance directly shorting the voltage source in the equivalent Thevenin circuit. The efficiency of the channel as an electrical generator is computed. (auth)

23774 ASYMPTOTIC GROWTH OF A BUBBLE IN A LIQUID WITH UNIFORM INITIAL SUPERHEAT. S. G. Bankoff (Northwestern Univ., Evanston, Ill.). Appl. Sci. Res., Sect. A, 12: 267-81(1963-64).

A modification is presented of the Plesset-Zwick solution for the asymptotic growth phase of a bubble originating in an infinite volume of liquid of uniform superheat. After a transformation to Lagrangian coordinates, the heat conduction equation is solved by a perturbation method, noting that the volume of the thermal boundary layer surrounding the bubble is small compared to the bubble volume. A solution for the first-order perturbation, and an estimate of the second-order perturbation, are presented for the first time. The perturbation series in the bubble volume is of the order of a descending series of powers of the Jakob number, and hence may not converge near the critical pressure. (auth)

23775 AN ANALYTICAL STUDY OF HEAT TRANSFER IN A FLUID FUEL NUCLEAR REACTOR. Itaru Michiyoshi and Ryuichi Matsumoto. Tech. Rept. Eng. Res. Inst., Kyoto Univ., 14: 29-39(Feb. 1964).

Heat transfer in a circular tube is examined for both uniform wall heat flux and uniform wall temperature, using previous analytical results. A pseudoplastic fluid is assumed. Velocity profiles, temperature variations of fluid and wall along the flow direction, heat flux at the wall, and the ratio of the heat contributing to the fluid temperature rise to the internally generated heat within the fluid are graphically illustrated. (D.C.W.)

23776 STUDIES ON TRANSIENT HEAT TRANSFER IN THE HETEROGENEOUS WATER REACTOR. PART II. Shigenori Hayashi, Akira Sakurai, and Tetsuo Iwazumi. Tech. Rept. Eng. Res. Inst., Kyoto Univ., 14: 41-59(Mar. 1964).

The surface temperature rise of the fuel clad was calculated from the reactor power rise of SPERT-1 step transient tests under the assumption that the cooling water does not flow during the power excursion. By comparing the analytical result with the experimental result, the moment at which the cooling water begins to be mixed by the flow of cooling water or the creation of bubbles was established. The heat flux transferred from the fuel clad to the cooling water was also calculated using the experimental results of the power and surface temperature determinations. The relation between the transient heat transfer and coolant flow during the power excursions of the long reactor periods and the process of transient heat transfer during the power excursions of the short reactor periods were studied using the calculated results. (auth)

23777 COMPRESSIBLE MAGNETOGASDYNAMIC CHANNEL FLOW. Fred E. C. Culick (California Inst. of Tech., Pasadena). Z. Angew. Math. Phys., 15: 126-43 (Mar. 25, 1964).

The steady, one-dimensional flow of an electrically conducting fluid in a straight channel with variable cross section is investigated. Interpretation of solutions in the velocity-Mach number plane is considered. Calculations are made for uniform electric and magnetic fields and nonuniform magnetic field. (D.C.W.)

23778 SOME RECIPROCAL RELATIONS IN ROTATIONAL MAGNETOGASDYNAMIC FLOW. Geoffrey Power (Univ. of Nottingham, Eng.) and Dennis Walker. Z. Angew. Math. Phys., 15: 144-54(Mar. 25, 1964).

Some reciprocal relations are established for two-dimensional, steady, rotational, magnetogasdynamic (MGD) flows of inviscid, thermally-conducting fluids with infinite conductivity. It is shown that, by use of certain reciprocal relations, the rotational MGD flow of a gas with arbitrary equation of state can be linked to a four-parameter class of rotational gas flows, each with its own equation of state. It is also shown that, under certain restrictions, shocks are permitted in the transformation from MGD to reciprocal flows. (D.C.W.)

23779 INTEGRATION OF LARGE RADIATORS WITH NUCLEAR ELECTRIC SPACECRAFT SYSTEMS. Kenneth G. Hagen (General Electric Co., King of Prussia, Penna.). New York, Society of Automotive Engineers, 1964, Preprint 845D, 14p. (CONF-505-2)

From Society of Automotive Engineers Air Transport and Space Meeting, New York, Apr. 1964.

Some of the more significant interactions between the radiator and vehicle of nuclear electric spacecraft are considered. This includes the selection of indirect versus direct condensing in the radiator; meteoroid armor and bumper criteria; booster constraints; aero shroud and structural integration; the significance of headers and feeds, electric transmission lines, and nuclear radiation shielding; and the magnitude of the structure contribution to system optimization. It is concluded that a conical or cylindrical radiator is the lightest and most generally applicable configuration from an overall system viewpoint. (auth)

Materials Testing

Refer also to abstract 23780.

23780 (SWRI-1243-11) DEVELOPMENT OF NONDESTRUCTIVE TESTING INSTRUMENTATION FOR REACTOR PRESSURE VESSELS. Fifth Quarterly Report, January 1, 1964 to April 1, 1964. Warren J. McGonnagle (Southwest Research Inst., San Antonio). Apr. 10, 1964. Work performed under United States—Euratom Joint Research and Development Program. Contract AT(11-1)-1243. 52p. (EURAEC-1051)

The purpose of this investigation is to develop a nondestructive testing technique for measuring the shift in the nil ductility transition temperature of reactor grade steels. Attention is directed toward simulating the shift in nil ductility transition temperature resulting from metallurgical mechanisms rather than radiation effects. The first technique employed is cold rolling, which produces significant changes in the transition temperature with no obvious grain growth. Magnetoabsorption, thermal conductivity, electrical resistivity, low-frequency internal friction, magnetics, ultrasonic attenuation, and the Barkhausen effect are being investigated for determining the effect of cold work on steel. Measurements are being made on irradiated pressure vessel steels. Electrical-resistivity and ultrasonic-attenuation measurements have been made. (auth)

GEOLOGY AND MINERALOGY

General

23781 (NP-13943) PROCEEDINGS. SYMPOSIUM ON DETECTION OF UNDERGROUND OBJECTS, MATERIALS AND PROPERTIES, 19-20 MARCH 1962. Stephen E. Dwornik (Army Engineer Research and Development Labs., Fort Belvoir, Va.). 254p. (CONF-421)

Eighteen papers are included; separate abstracts have been prepared for 2. One paper was previously abstracted in NSA, and appeared as abstract number 18: 19500. The remaining 15 papers concern the detection and analysis of underground objects and formations. (T.F.H.)

For abstracts of individual papers see: 23782 and 23783.

23782 (NP-13943(p.117-27)) DETECTION OF UNDERGROUND OBJECTS BY BACK-SCATTERED RADIATION. Charles H. Dyer (Naval Ordnance Lab., White Oak, Silver Spring, Md.).

The feasibility of using backscattered radiation for detecting non-metallic underground objects was studied. An equation was developed that gave the change in backscattered intensity as a function of a number of parameters. In general, the method consists of directing an x-ray beam into the earth and analyzing the backscattered radiation. An absolute measurement of the backscatter can be made with a meter. If a collimator is placed in front of the meter's sensitive element an area can be scanned. Another method of studying the backscatter radiation is by imaging it on x-ray film using a pinhole camera. The amount of backscatter from an underground object is dependent on the density, atomic number, and size of the object, on the energy of the incident radiation and on the depth the object is buried. As the density and atomic number of an object approaches that of the soil in which the object is buried the probability of detection approaches zero. The detectability of an object decreases rapidly the deeper it is buried and detection becomes impossible when the object is covered by about six inches of soil. Soil inhomogeneities such as stones, voids, roots and depressions will cause changes in the amount of backscatter. When an object is expected to give a small change in backscatter its signal can be masked by the effects of soil inhomogeneity. In general, although dense objects can be detected buried under several inches of soil, objects of low density are difficult to detect even near the surface. (auth)

23783 (NP-13943(p.209-14)) HYDRODYNAMICS OF UNDERGROUND NUCLEAR EXPLOSIONS. D. C. Anderson (Army Engineer Research and Development Labs., Fort Belvoir, Va.).

An analytical solution is presented, which, by accounting for the magnitudes of the kinetic, potential (stored hydrodynamic), and waste heat energies, enables the prediction of the decay history of the blast waves from an underground nuclear explosion. The Rankine-Hugoniot properties of the medium in which the explosion occurs must be known or estimated. (T.F.H.)

23784 (NP-13956) LAKEWOOD CONFERENCE PROCEEDINGS: HIGH FREQUENCY SEISMIC ENERGY. VESIAC Special Report. (Michigan. Univ., Ann Arbor. Inst. of Science and Tech.). Apr. 1964. 101p.

Four papers given in connection with the conference on high-frequency seismic energy held at Lakewood, Colorado, on October 15 and 16, 1962, and a series of summary and evaluative comments on this meeting offered by several of the attendees are presented. The effects of different types of sources on high-frequency signals, the attenuation of short-period P waves in the mantle, and the amplitudes of P waves over an 1100-km profile are discussed; and work on high-frequency energy from earthquakes is summarized. (auth)

23785 (PG-Report-577) THE BIOLOGY OF THE SOLWAY FIRTH IN RELATION TO THE MOVEMENT AND ACCUMULATION OF RADIOACTIVE MATERIALS. VIII. SEA-BED AND SEA-SURFACE DRIFTER RELEASES. B. SOLWAY FIRTH 1963. E. J. Perkins, M. Bailey, and B. R. H. Williams (United Kingdom Atomic Energy Authority. Production Group. Chapelcross Works, Annon, Dumfriesshire, Scotland). 1964. 37p.

Releases of sea-bed and sea-surface drifters in the Solway Firth, during the period January 15, to April 17, 1963, are described. The dominant effect of tidal mechanisms upon the transport of sea-bed drifters is again apparent. Sea-surface drifters were dispersed most widely and rapidly under conditions of enhanced run-off and prolonged east to north-east winds. (auth)

23786 (UCRL-13105) CHANGES IN PHYSICAL PROPERTIES OF ROCKS IN THE VICINITY OF AN UNDERGROUND NUCLEAR EXPLOSION. M. Mehta, V. S. Gupta, and W. H. Somerton (California. Univ., Berkeley). Feb. 7, 1964. For Univ. of California, Inst. of Engineering Research, Berkeley. Contract [W-7405-eng-48]. 29p.

An investigation was made on the effects of underground nuclear explosions on the physical properties of rocks. Samples tested consisted of two preshot and 20 postshot granites taken from various distances along a core hole that intersected the shot cavity. Physical properties measured included porosity, bulk density, permeability, sonic velocity, crushing strength (ultimate compressive strength), and dynamic elastic constant. Graphs of physical properties plotted against distance from the shot, show large changes in all physical properties in the immediate vicinity of the shot. At greater distances from the shot, changes are much less in magnitude but they do persist. Porosity and permeability increase while other properties decrease in magnitude in the direction of the shot. Data are tabulated. (P.C.H.)

23787 ON THE URANIUM CONTENT OF SEDIMENTS OF THE WESTERN BASIN OF THE MEDITERRANEAN. Marcel Goldsztein (Service de Minéralogie, D.P.R.M., Fontenay-aux-Roses, France) and Joaquin Ros. Bull. Inst. Oceanog., 19p.(Sept. 1963). (In French)

Also issued as IAEA Radioactivity in the Sea, Publication No. 3, Sept. 1963.

The U content of the sediments of the Mediterranean sea was studied. Three hundred samples were analyzed from the French Continental Shelf, from the Balearic Continental Shelf, and from the Abyssal Plain. The average U content is 2.3 ppm. In the sediments of the Continental Shelves, 60% of the U is leachable with 2N nitric acid; while this figure is 36% in the sediments of the Abyssal Plain. (auth)

23788 DETERMINING THE ABSOLUTE AGE OF MAMMOTH AND WOOLLY RHINOCEROS FOSSIL REMAINS FROM THE SIBERIAN PERMAFROST BY MEANS

OF C^{14} DATING. A. E. Geints and V. E. Garutt (Oslo Univ. and Zoological Inst., Academy of Sciences, Leningrad). Dokl. Akad. Nauk SSSR, 154: 1367-70(Feb. 21, 1964). (In Russian)

Samples of the animal remains were scraped, and treated with 5% HCl to remove carbonate contamination. A number of samples were treated with NaOH to remove humic acids. The samples were burned to CO$_2$ in pure oxygen, and ^{14}C was counted on a proportional counter. It was found that repetition of the caustic treatment resulted in a greater age for the sample. Hence, the ages quoted for the samples may be less than the actual ages. Two mammoth samples gave ages of >39,000 years. Three other mammoth samples gave ages of 32,500 to 33,500 years, and one woolly rhinoceros sample showed an age of 38,000 years. One woolly mammoth sample gave a young age of 11,450 years. (TTT)

Natural Radioactivity and Fallout

Refer also to abstracts 23790 and 23819.

23789 (AEET/AM/39) MEASUREMENTS ON THE ENVIRONMENTAL RADIOACTIVITY IN INDIA FROM NUCLEAR WEAPON TESTS DATA COLLECTED DURING 1962-63. (India. Atomic Energy Establishment, Trombay). Dec. 1963. 65p.

Supplement to AEET/AM/26.

Data are tabulated on the radioactivity due to fallout in samples of air, precipitation, and in milk and other foods collected in India during 1962 and 1963. (C.H.)

23790 (NP-13828) RADIOAKTIVITETSMÄTNINGAR PÅ LIVSMEDEL 1962. PRELIMINAR RAPPORT. (Radioactivity Measurements on Food Materials, 1962. Preliminary Report). Kay Edvarson (Sweden. Försvarets Forskningsanstalt, Stockholm); Lars Fredriksson (Sweden. Statens Lantbruksförsok, Ultuna); Bo Lindell (Sweden. Kungliga Karolinska Medico-Kirurgiska Institutet. Radiofysiska Institutionen, Stockholm); and Bertil Åberg (Sweden, Kungliga Veterinärhögskolan, Stockholm). 88p.

A special group of experts was established by the Swedish Radiation Protection Board in order to prepare a program for coordinated measurements on radioactivity in foodstuffs. The preliminary results of measurements made during the summer and autumn of 1962 are presented. The most important results are also given in English. The apparatus used in the measurement and the measurement program set-up are described. The radioactivity of milk, meat, corn, fish, and vegetables with respect to ^{137}Cs, ^{40}K, ^{131}I, and ^{222}Rn was determined. The radioactive fallout of ^{137}Cs, ^{131}I, ^{89}Sr, ^{90}Sr, ^{95}Zr/^{95}Nb, and ^{222}Rn were also measured. (J.S.R.)

23791 (NYO-10496(Add.)) HIGH ALTITUDE BALLOON SAMPLING PROGRAM. QUALITY CONTROL. Quarterly Report No. 1, Fernando Bazan and P. W. Krey (Isotopes, Inc., Westwood, N. J.). Apr. 24, 1964. Contract AT(30-1)-3276. 21p.

The internal quality control program during the radiochemical analysis of air filter samples for fallout fission products is described. Both blank and standard nuclide samples were used. (C.H.)

23792 (WP/37) A NOTE ON THE STRONTIUM-90 CONTENT OF MARINE ORGANISMS AS AN INDEX FOR VARIATIONS OF STRONTIUM-90 IN SEA WATER. Rinnosuke Fukai (International Atomic Energy Agency, Vienna). Dec. 16, 1963. 17p.

The ^{90}Sr content of marine organisms was found to provide an index to the concentration of ^{90}Sr by sea water over a period of time. The ^{90}Sr content of brown algae, zoöplankton, starfish, clams, and salmon from the Pacific Ocean in the vicinity of Japan showed a maximum in 1959 followed by a relatively rapid decrease by the end of 1961. Data values agreed with observed values for ^{90}Sr content of sea waters in the vicinity of Japan during this time. (C.H.)

23793 OBSERVATION OF FALLOUT AROUND OUR LABORATORY. Tesuo Mamuro, Akira Fujita, Tadao Matsunami, Kazuko Yoshikawa, and Nobufami Maki. Ann. Rept. Radiation Center Osaka Prefect., 4: 1-3(1963).

The results of observations on fallout content in rain and artificial activity in the atmosphere during 1963 are discussed, and data are tabulated. (P.C.H.)

23794 X-RAY MICROANALYSIS OF HIGHLY RADIOACTIVE FALLOUT PARTICLES. Tetsuo Mamuro and Akira Fujita. Ann. Rept. Radiation Center Osaka Prefect., 4: 4-8(1963).

X-ray microanalysis was carried out in order to determine the main metallic elements in a highly radioactive particle and to investigate the relation between the color of a particle and its chemical composition. The existence of Fe, Al, and Si was clearly recognized from the spectra. It was also found that the composition ratio of Fe to Al increases with the darkness of color. Data are tabulated. (P.C.H.)

23795 SOLUBILITY OF FALLOUT PARTICLES. Tetsuo Mamuro, Tadao Matsunami, and Nobufumi Maki. Ann. Rept. Radiation Center Osaka Prefect., 4: 16-19 (1963).

The solubility of highly radioactive fallout particles collected during 1961 and 1962 was investigated. Of four particles examined, a dark reddish brown particle was the most insoluble in 6 N HCl. A light reddish brown one and a black one were less insoluble. It is suggested that there is a composition ratio of Fe to Al at which a particle takes the most insoluble state. Particles of light color, which are extremely rich in Al, and black particles, which are extremely rich in Fe, seem to be less insoluble. The same results were obtained with 6 N ammonia water. Highly radioactive fallout particles were also found to be dissolved completely by sodium carbonate and sodium bisulfate fusion. (P.C.H.)

23796 ARTIFICIAL RADIOACTIVE DUST PARTICLES COLLECTED BY AN ELECTROSTATIC PRECIPITATOR. Akira Fujita and Tetsuo Mamuro. Ann. Rept. Radiation Center Osaka Prefect., 4: 20-3(1963).

An electrostatic precipitator was used to study fallout particles smaller than a few μ in diameter. It was found that such particles are multiply charged and show high mobility in an electric field. Also, the dust particles of large ionic mobility made larger spots on autoradiographs. The results suggest that the radioactive dusts of larger ionic mobility consist of considerably larger particles, instead of very fine particles. All of the radioactive fallout particles emit beta rays. (P.C.H.)

23797 RADIOACTIVE CONTAMINATION OF VEGETABLES WITH FALL-OUT. Kazuo Nishio and Atsuhiko Takeda. Ann. Rept. Radiation Center Osaka Prefect., 4: 126-7(1963).

Results of monitoring the radioactive contamination of vegetables in Osaka Prefecture from Oct. 1961 to Dec. 1963, and characteristics of the contamination are reported. The contamination of open cabbage leaves was far higher than that of the inner leaves. Relatively high values were also obtained from leaves of white radish, carrots, and spinach. The results seem to indicate that open leaves or jaggedly complicated and piliferous leaves are apt to be contaminated by direct contact with fallout. Data are tabulated. (P.C.H.)

23798 RESULTS OF MEASURING ATMOSPHERIC FALLOUT IN THE YEARS 1962-63 AFTER MEGATON TESTS. Vilém Santholzer (Charles Univ., Hradci Králové, Czechoslovakia). Cesk. Casopis Fys., 14: 1-4(1964). (In Czech.)

In 1962 and as late as July 1963 monthly activities were of the order of ten mc/km^2 as a consequence of the megaton nuclear tests carried out in 1961 to 62. In spring 1962 and 1963, a considerable spring increase was apparent to a very high degree, especially in May and June 1963 when the activity increased 6 to 7 times as compared with that of February and March 1963. It is suggestive of the existence of a stratospheric reservoir of artificial radioactivity formed after megaton tests. The approximately double increase in the activity in November and December 1962 had a tropospheric character. It was a fresh activity resulting probably from nuclear tests carried out in August 1962. The essentially higher activity in May and June 1963 belonged to nuclides with longer half lifes. It was connected with the movements of the air masses in the stratosphere and with the penetration of stratospheric air into the troposphere in spring. The measured activity, which is comparatively high, proves that the stratospheric reservoir is filled to a considerable extent and that the spring increase will probably be apparent as late as 1964, even if further megaton tests are not carried out. (auth)

23799 NUCLEAR ENERGY AND METEOROLOGY. THE CONTROL OF ARTIFICIAL ATMOSPHERIC RADIOACTIVITY. H. Bocquet. Meteorologie, 4: No. 65, 2-32 (Jan.-Mar. 1962). (In French)

The effects at a world-wide scale of the fallout from experimental tests are obviously dangerous for man either in a direct way with soil or atmospheric pollution or by the introduction in the food chain. An estimation of the danger presented by the radionuclide contamination is essentially based on the permanent control of the specific activity of the atmosphere. For this purpose the network BABAR is operating since 1958 by the National Service of Civil Defense. The data are carefully checked and compared with the meteorological parameters in collaboration with the scientists of the French Weather Bureau. The air sampling recording apparatus used give both short period fluctuations of the specific activity of the air and dangerous long-lived fission product which are studied separately. This network of accurate measurements is completed by investigations of surface waters, drinking waters, sea water, and food chain. All these controls and measurements are checked up by the French Interdepartmental Technical Committee for all the topics in connection with the European Atomic Energy Community where the Health Physics Subcommittee is specially in charge of all the problems involved by the coordination and control of fission products activity. The following items are mainly described: mechanisms of tropospheric and stratospheric fallout, and specific activity of the air masses during September and October 1961. (auth)

23800 STUDIES ON THE QUANTITATIVE DISTRIBUTION OF RADIOACTIVE FALLOUT PRODUCTS IN MILK. H. Lagoni, O. Paakkola, and K. H. Peters. Milchwissenschaft, 18: 340-4(1963).

The distribution of radionuclides in some milk products was studied. Cream contained 8% of the ^{90}Sr, 16% of the ^{131}I, and 15% of the ^{137}Cs in whole milk; of these amounts, 16, 22, and 15%, respectively, were retained in butter made from the cream. Of the ^{131}I in butter, 60% was in the fat, whereas 100% of the ^{137}Cs and ^{90}Sr was in the butter serum. In skim milk, almost all of the isotopes were in the sera and were not precipitated with the proteins; the exception was ^{90}Sr, 92% of which remained in the curd when skim milk was treated with rennet. (auth)

23801 RUBIDIUM/STRONTIUM AND STRONTIUM-87/STRONTIUM-86 RATIOS IN DEEP CRUSTAL MATERIAL. Nature, 202: 477-8(May 2, 1964).

A brief discussion of the evidence for a chemical differentiation of the crustal material through metamorphic processes is presented. Rubidium/strontium ratios in deep crustal material and the separation of ^{87}Sr and ^{86}Sr in geological processes are discussed. (C.E.S.)

23802 UNIDENTIFIED EXCESS ALPHA-ACTIVITY IN THE 4.4-Mev REGION IN NATURAL THORIUM SAMPLES. R. D. Cherry, K. A. Richardson, and J. A. S. Adams (Rice Univ., Houston, Tex.). Nature, 202: 639-41(May 16, 1964).

An unidentified alpha activity with an energy of about 4.4 Mev found in thorite minerals is reported. Positive identity of the source of this activity could not be determined. (C.E.S.)

23803 ON THE MEASUREMENT OF EFFECTIVE ATMOSPHERIC RADIOACTIVITY IN CHACALTAYA. C. J. Bland and J. A. Ruiz (Universidad Mayor De San Andres, La Paz, Bolivia). Publ. Lab. Fis. Cosmica, Univ. Mayor San Andres, No. 24, 47-50(May 1963). (In Spanish)

An analysis correlating data on radioactivity in the air, measured at Chacaltaya, and data on atomic bomb explosions showed that it is consistent with a time delay of seven days between one explosion and the consequent increase of radioactive fallout. (auth)

23804 RADIOLOGICAL HEALTH DATA [MONTHLY REPORT], VOLUME V, NUMBER 5. (Public Health Service, Washington, D. C.). May 1964. 47p. $0.50(GPO).

Data are presented on radioactivity due to fallout fission products in samples of airborne particulates, precipitation, surface waters, and milk collected throughout North America during Jan. 1964. Results are included from some fallout measurements made during 1963. Data are presented on the ^{90}Sr content in selected grains from the 1963 harvest and the effect of typical food preparative procedures on the ^{90}Sr content of canned or frozen peaches, tomatoes, snap beans, broccoli, and spinach. Results are reported from measurements of environmental radioactivity during 1962 and 1963 at the Feed Materials Production Center, Fernald, Ohio, and the Feed Materials Production Facilities, Weldon Springs, Mo. Four underground intermediate yield nuclear detonations at the Nevada Test Site were reported during April 1964. A separate abstract was prepared for one section of this report. (C.H.)

For abstract of an individual section see: 23833.

Site Survey and Selection

Refer to abstract 23832.

Techniques and Equipment

23805 (UCRL-Trans-1037(L)) IT IS IMPOSSIBLE TO CONCEAL AN ATOMIC EXPLOSION. Iu. Rybchinskii. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Livermore), from Nauchn.-Tekhn. Obshch. SSSR, 4: No. 10, 44-6(1962). 12p.

The contention is presented that all nuclear explosions can be detected by existing means and differentiated from natural phenomena. Some supporting evidence is cited, and some techniques and installations used in Russia for such operations are briefly discussed. (D.C.W.)

Thorium and Uranium Minerals

23806 THE ENRICHMENT OF URANIUM ON PEAT. Johanna Andraschko, P. Stipanits, and F. Hecht (Universität, Vienna and Österreichische Studiengesellschaft fur Atomenergie GmbH, Vienna). Mikrochim. Ichnoanal. Acta, No. 1, 124-35(1964). (In German)

The exchange and adsorption mechanisms that are active in the accumulation of trace elements, especially uranium, in peats under natural circumstances were studied. The maximum ion exchange capacity of peat for Mg, Fe, and U were found to be around 0.3 to 0.5 mval/g. (auth)

HEALTH AND SAFETY

Refer also to abstracts 23789, 23800, and 23804.

23807 (AED-C-21-01) DOSIMETRY (HEALTH PHYSICS). AED Information Service Bibliographies. K. Becker, comp. (Kernforschungsanlage, Julich, Germany). Feb. 1964. 181p.

In English and German.

Seven hundred forty-one references are presented. (H.M.G.)

23808 (AERE-R-4084) A PORTABLE SHOWER CABINET. W. K. Curtis (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1964. 13p.

A portable shower cabinet is described for use in areas where a toxic hazard exists. (C.H.)

23809 (AERE-R-4528) HEALTH PHYSICS CONTROL OF A.E.R.E. RESEARCH REACTORS. W. B. Woollen, E. M. Flew, J. E. Cook, R. L. Gardiner, B. T. James, and A. Martin (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1964. 69p.

Separate abstracts were prepared for five sections of this report. (C.H.)

For abstracts of individual sections see: 23810, 23811, 23812, 23813, and 23814.

23810 (AERE-R-4528(p.1-24)) HEALTH PHYSICS CONTROL OF A.E.R.E. RESEARCH REACTORS. PART I. GENERAL CONSIDERATIONS. W. B. Woollen (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

Brief descriptions are presented of the six AERE reactors and their working cycles. The nature of hazards involved in operation of the reactors is surveyed and control and safety measures are described. (C.H.)

23811 (AERE-R-4528(p.25-33)) HEALTH PHYSICS CONTROL OF A.E.R.E. RESEARCH REACTORS. PART II. SPECIAL MONITORING TECHNIQUES AND RADIATION SPECTROMETRY IN CONTAMINATION CONTROL. E. M. Flew and R. L. Gardiner (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

Contamination control in the areas of the DIDO and PLUTO reactors is described. Beta and gamma spectrometers are used to augment general-purpose monitoring instruments for the determination of radioactivity in samples of air and dust and measurement of surface contamination. (C.H.)

23812 (AERE-R-4528(p.35-47) HEALTH PHYSICS CONTROL OF A.E.R.E. RESEARCH REACTORS. PART III. THE CONTROL OF TRITIUM IN HEAVY WATER IN DIDO CLASS REACTORS. B. T. James and E. M. Flew (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

Potential hazards from tritium exposure are reviewed. Procedures used for the control of tritium in D_2O in the DIDO reactors are described. The use of urine analysis for monitoring personnel for tritium exposure is discussed. (C.H.)

23813 (AERE-R-4528(p.49-53)) HEALTH PHYSICS CONTROL OF A.E.R.E. RESEARCH REACTORS. PART IV. EXPERIENCE WITH BEAMS FROM REACTORS. J. E. Cook (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

The occurrence of intentional, operational, and accidental beams of mixed neutron and γ radiations in reactor areas is discussed. Procedures used for the dosimetry of radiation beams are described. Several incidents of accidental exposure to beams of radiation at the DIDO reactors are described. (C.H.)

23814 (AERE-R-4528(p.55-67)) HEALTH PHYSICS CONTROL OF A.E.R.E. RESEARCH REACTORS. PART V. EXPERIENCE IN THE FUEL ELEMENT CROPPING AND IRRADIATION PONDS AT A.E.R.E. HARWELL. J. E. Cook and A. Martin (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

The ponds and facilities where spent fuel elements from DIDO reactors are stored are described. Methods used for the control of radiobiological hazards are discussed. (C.H.)

23815 (AERE-R-4601) ACTIVITY INDUCED IN FOOD BY ELECTRON, X-RAY AND COBALT-60 GAMMA IRRADIATION. R. Rogers (United Kingdom Atomic Energy Authority. Research Group. Wantage Research Lab., Wantage, Berks, England). Apr. 1964.

In order to estimate the possible extent of the radiation hazard that might arise from the irradiation of food, a survey of relevant nuclear reactions was made. Semi-empirical formulas, derived from published determinations of activities induced in a number of nuclides, were used to calculate activities due to similar reactions in other nuclides. Irradiation by ^{60}Co γ rays and by 5, 7, 10, and 15 Mev electrons and x rays was considered. These results were combined with independent estimates of the maximum concentrations of the elements that could credibly exist in a diet, giving upper limits for the activities that might be induced. More typical concentrations of the elements were used in a separate series of calculations. Since the activities in terms of curies are not biologically comparable, they were expressed as fractions of the maximum permissible concentrations in drinking water for public use. The estimates must be viewed in relation to the postulated concentrations of the elements. In the case of the maximum credible concentrations the highest of several opinions was taken for each element. (auth)

23816 (AHSB(S)R-64) AN ASSESSMENT OF ENVIRONMENTAL HAZARD FROM FISSION-PRODUCT RELEASES. J. R. Beattie (United Kingdom Atomic Energy Authority. Authority Health and Safety Branch, Risley, Lancs, England). May 16, 1961. 90p.

Hazards to the health of the general public which could be expected to arise from a release of fission products following a reactor accident are assessed. The proportions of fission products in the reactor are assumed to be those resulting from a continuous period of operation at power, and a preferential release of the more volatile fission products is supposed to have occurred. The proportions of fission products comprising the assumed release were chosen after consideration of data from the Windscale accident, and data from laboratory-scale tests reported in the literature. Sufficient information is included to enable the important effects of other fission product mixtures to be assessed. The dispersion of a release in the atmosphere is discussed and preferred curves of concentration vs distance are given, based on Pasquill's work, for average weather and inversion condition. A release over a period of a few hours is assumed. Allowance is made for the depletion of activity by deposition from the cloud as it travels downwind; this correction is more important in inversion conditions. Preferred curves of deposited activity vs distance are given for the two weather conditions. The frequency of occurrence of average weather and inversion conditions is discussed, and figures are given for several sites in the U. K. Reference is made to authoritative recommendations on the maximum permissible levels of exposure of the general public in the period following a reactor accident. Where such recommendations are not as yet available, appropriate values are deduced from other authoritative recommendations by using the best available supplementary data, avoiding the introduction of arbitrary assumptions wherever possible. Limiting ranges of hazard are calculated corresponding to the various maximum permissible levels of exposure and other levels of interest. The hazards of external radiation emanating from the radioactive cloud or from deposited radioactivity are discussed, followed by a detailed consideration of internal radiation hazards, i.e., hazards from inhaled or ingested radioactive substances in particular isotopes of I, Cs, and Sr. Special attention is given to the hazards from inhaled or ingested I. Tentative assessments are made in the case of ^{106}Ru, ^{140}Ba, and ^{144}Ce, for which authoritative recommendations do not as yet exist regarding maximum permissible exposure in emergency conditions. The magnitudes of various releases are specified in terms of the activity of the ^{131}I component of the release, because of the over-riding importance of this isotope in relation to hazards to public health following a reactor accident. However, the hazards from other fission product elements and isotopes are also assessed. The probable consequences of releases in the size range 1 to 10^5 C of ^{131}I are considered. Additional graphs are provided, from which ranges of hazard from ^{137}Cs or ^{90}Sr can be assessed if the activities of these isotopes in the release should be known. Recommendations arising from the data are included. (C.H.)

23817 (ANL-6880(p.72-8)) NUCLEAR SAFETY. (Argonne National Lab., Ill.)

Safety studies for thermal and fast reactors are summarized. Particular attention is devoted to experiments in TREAT on reactions of fuel pins with water during transients; meltdown of Nb−Zr clad UC fuel pins during transients; analysis of transients in fuel pins in Na-cooled loops; and installation of instruments in TREAT loops. Measurements are reported of the reactions of Al−U alloys with steam at 1200 to 1600°C; thermal conductivity of $Zr-ZrO_2$ systems at 0 to 85% ZrO_2 at 24°C; and analysis of thermite-type reactions between Al and U_3O_8. (T.F.H.)

23818 (AWRE-0-93/63) THE AUTOMATIC PROCESSING AND EVALUATION OF FILM BADGE DOSIMETER DATA AT AWRE. T. G. Pegg, W. N. Saxby, and D. M. Wallace (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Mar. 1964. 23p.

The introduction of a new multifilter film badge for personal radiation dosimetry and the appearance of detailed statutory requirements for recording personal radiation doses led to the development of a semi-automatic system for processing and recording film badge data. A system using the IBM 1401 computer to produce certificates giving details of radiation doses received by individuals is described. The method of data measurement, dose evaluation, and the computer services used are discussed. Brief comments on operational experience and costs are included. Figures illustrate the processing and recording system. (C.H.)

23819 (CEA-R-2409) LES POLLUTIONS RADIOACTIVES DU LAIT PAR L'IODE 131 DU 1ER SEPTEMBRE 1962 AU 1ER FEVRIER 1963. (Radioactive Pollution of Milk by Iodine-131 From September 1, 1962 to February 1, 1963). Georges Michon and Claude Madelmont (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). Apr. 1964. 46p.

Results are presented from 840 examinations and analyses of ^{131}I in milk during 1962 and 1963 when young fission products were detectable in radioactive fallout. The correlations between the values found in milk, changes in atmospheric radioactivity, and rainfall are discussed. It is concluded that the rain is the most important factor in the pollution of milk by ^{131}I. (C.H.)

23820 (EGCR-4) RADIOLOGICAL HEALTH MANUAL—RADIATION PROTECTION STANDARDS AND REGULATIONS. (Tennessee Valley Authority, Oak Ridge, Tenn.). Mar. 26, 1964. Contract AT(40-1-2742. 156p.

Radiation protection standards and regulations are presented for the operation of the Experimental Gas Cooled Reactor. (C.H.)

23821 (HI-303-RR) SPECIAL ASPECTS OF ENVIRONMENT RESULTING FROM VARIOUS KINDS OF NUCLEAR WARS. PART II. THE USE OF SCENARIOS FOR EVALUATING POSTATTACK DISUTILITIES. Robert U. Ayres (Hudson Inst., Inc., Croton-on-Hudson, N. Y.). Jan. 8, 1964. Contract OCD-OS-62-218. 119p. (AD-430059)

Various approaches were explored to help identify the most salient environmental disutilities which might result from a nuclear war. Particular attention was directed toward an attempt to evaluate the likelihood of occurrence (assuming a nuclear attack of specified kind) and the severity of the effects. The principal analytic tool used is the scenario. Twelve scenarios were written covering a wide range of attacks and weapons effects. Each scenario is accompanied by a detailed commentary including examples of similar past events, relevant data (or sources), discussion of the applicability of the chosen examples and possible branch points which would result in similar or parallel series of events. In connection with each scenario is also included a list of possible specific protective measures and countermeasures. A unified discussion of all the countermeasures suggested by the scenarios is presented. The discussion is illustrated by a possible environmental countermeasures budget of moderate size (~25 million dollars) guided, at least partly, by some specific cost-effectiveness criteria. The principal conclusion was that, for small to medium budgets, postattack information gathering and dissemination probably offer the best value for money, though stockpiling of selected items might reasonably absorb an increased share of larger budgets. In addition to the scenarios some source material (outbreaks and invasions; natural disasters such as earthquakes, volcanoes, meteorites, storms, and fires) was included. (auth)

23822 (HI-303-RR/A-IV) SPECIAL ASPECTS OF ENVIRONMENT RESULTING FROM VARIOUS KINDS OF NUCLEAR WARS. PART II, ANNEX IV. EFFECTS OF THERMONUCLEAR WAR ON WEATHER AND CLIMATE. Robert U. Ayres (Hudson Inst., Inc., Croton-on-Hudson, N. Y.). Jan. 8, 1964. Contract OCD-OS-62-218. 29p. (AD-430098)

An admittedly superficial view of some possible consequences of a thermonuclear war for weather and climate suggests the possibility of a sequence of meteorological and climatic events roughly as follows following an attack of 10,000 MTs (ground-burst): initial widespread dirty (contaminated with fallout) rains and/or snow lasting several weeks; fairly heavy haze in the stratosphere, gradually disappearing over a period of several (i.e., 3 to 4) years; many forests on lower slopes killed or weakened by radiation, followed by insect outbreaks (2nd, 3rd, and subsequent years); enhanced wind and water erosion where plant cover is depleted; loss of forest cover on watersheds resulting in higher soil temperatures; and ultimately, higher ground temperatures, fewer forests, some marginal lands turned into desert, and many river valleys damaged by floods. (auth)

23823 (HW-65268) FISSION PRODUCT SHIPPING CASK. Design Criteria and Hazards Evaluation. C. W. Smith (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 20, 1960. Contract W-31-109-eng-52. 48p.

To provide a cask design which is conservative with respect to radiation hazards and at the request of the Atomic Energy Commission, a shipping cask was designed to conform to the applicable sections of the proposed fuel element shipping regulations and to meet the requirements of the Bureau of Explosives. The cask was designed for a shipment of 0.5 MC of ^{144}Ce and the associated impurities from Hanford to ORNL. The structural integrity of the cask was assured by providing a protective buffer to distribute forces from impacts with solid surfaces or sharp objects over the cask surface. With this distribution of forces and the stiffness provided by the external fins, the cask will stand a force of 50 G without rupture. The cask has adequate shielding to more than meet radiation regulations with over twice the nominal load. Sufficient surface was provided for heat dissipation during normal operations and the cask has sufficient heat capacity to be self-sustaining for over 48 hours without danger of fission product decomposition and escape with 1.5 times the normal load of fission products, assuming the cask is completely and perfectly insulated. The outer cask surface will be about 210°F during normal operation and the maximum fission product temperature will be about 476°F. Procedures for loading and unloading were developed. Reference is made to regulations which govern the amount of removable contamination on the cask surface and also the labeling of radiation sources for shipment. (auth)

23824 (HW-81363) RADIOLOGICAL CONTROL EXPERIENCE WITH PLUTONIUM FUELS. Arthur R. Keene (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Mar. 26, 1964]. Contract AT(45-1)-1350. 14p. (CONF-514-1)

From Atomic Energy Commission Meeting on Commercial Fabrication on Plutonium Fuel, Richland, Wash., Apr. 1964.

Factors contributing to the radiotoxicity of Pu are reviewed. It is pointed out that the external exposure from x and γ emission from decay of Pu isotopes and the internal deposition of Pu materials can be well controlled by good facility design with emphasis on ventilation and exhaust air filtration, effective administrative controls, good housekeeping, and well-trained employees. Facilities and experience in the Hanford Laboratories Plutonium Fabrication Pilot Plant are cited as an example of radiological control in handling Pu fuels. (C.H.)

23825 (LADC-6104) PHYSIOLOGICAL PROPERTIES OF PLUTONIUM AND ASSESSMENT OF BODY BURDEN IN MAN. Wright H. Langham (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract W-7405-eng-36. 22p. (CONF-448-3)

From IAEA Symposium of the Assessment of Radioactive Body Burdens in Man, Heidelberg, Ger., May 1964.

The physiological properties of Pu are reviewed. Modes of absorption and exposure of man and methods used in attempts to assess the body burden are discussed. It is pointed out that there is no known satisfactory method of assessing Pu body burden in man under the more usually encountered conditions of exposure. However, during 20 yr experience with the production and processing of large quantities of Pu in the U. S., fewer than 50 workers have received exposures equal to or slightly greater than the maximum permissible body burden insofar as it is possible to assess a body burden. Not a single case of Pu poisoning has been observed in man. However, it is assumed that a delay of from 12 to 30 yr may be expected between time of exposure and appearance of symptoms of chronic radiation damage. (44 references.) (C.H.)

23826 (NP-13942) IMPROVEMENT OF PROTECTION DATA BASE FOR DAMAGE ASSESSMENT AND DATA BASE ON SHELTER NEEDS: AN EXAMINATION OF THE "PV" DATA FROM THE NFSS. Final Report: Volume III. Philip McMullan, Herbert Campbell, and Kenneth Willis (Research Triangle Inst., Durham, N. C.). [1964]. Contract OCD-OS-62-144. 38p.

The sensitivity of direct weapons effects fatality computations to the changes in structural protection indicated by the Physical Vulnerability (PV) data from the National Fallout Shelter Survey (NFSS) was examined. This examination was made as a preliminary to utilizing the PV data for existing damage assessment and vulnerability analysis routines such as those in the National Resource Evaluation Center's (NREC) Jumbo III system. An analysis of Columbus, Ohio, Sacramento, Calif., and Scranton, Penna., selected as three typical cities, subjected to direct weapons effects shows that when available NFSS shelters are utilized rather than residential dwellings alone, predicted fatalities based on Dikewood Corporation fatality curves decrease by at most 10% of the city's population. This analysis holds the population distribution and weapon characteristics invariant while changing only the structural protection afforded shelterees. It is unlikely that the reduction would approach this percentage except for a few selected city-attack combinations. It is recommended that no PV modifications be made in existing damage assessment routines for national assessments, even though only residential dwelling protection is assumed, until a further study of direct effects casualties in basements and core areas of NFSS structures is completed by the Dikewood Corporation. An analytical fatality computation procedure using the Weiss population distribution model and an analytic fatality-distance curve is also derived and its application to one city is illustrated. (C.H.)

23827 (NYO-2539-1) STRUCTURAL INTEGRITY OF SHIPPING CONTAINERS FOR RADIOACTIVE MATERIALS. PART II. SOME ASPECTS OF FIRE SIMULATION IN SHIPPING CONTAINER STUDIES. M. M. Reddi (Franklin Inst. Labs. for Research and Development, Philadelphia). Feb. 1964. Contract AT(30-1)-2539. 21p. (I-A2412-2)

Simulation of fire damage in shipping containers is discussed. Modeling requirements for simulating fires, heat transfer, and thermoelastic deformations were derived. The results showed that true modeling of a fire is not possible. However, if conduction and convection are neglected and thermal radiation alone is considered to be the energy transport mechanism in the fire, then modeling of steady-state thermo-elastic strain is shown to be possible when model and prototype boundary temperatures are alike. (auth)

23828 (UCRL-7637) HAZARDS CONTROL. Quarterly Report No. 15, October—December 1963. (California. Univ., Livermore. Lawrence Radiation Lab.). Contract W-7405-eng-48. 34p.

Experiments on thermoluminescence for personnel dosimetry indicated that magnesium will suppress the undesirable low-temperature glow peaks induced when LiF is doped with europium, calcium, or silver. It was found that loss of water from the Livermore Pool Type Reactor would not cause a serious radiation hazard. An apparatus was constructed for detecting fractional gram quantities of plutonium in dry waste containers. The water monitor for alpha contamination of the pool in Building 190 was modified to increase sensitivity and reliability. Molecular Sieves were found to be less efficient than activated charcoal in retaining airborne radioiodine, but provided better separation between gaseous and particulate forms. Tests of protective clothing designed by the Fire Protection Section showed that they provide complete protection in emergencies. A one-man method for operation of the pumper-snorkel fire fighter was developed. (M.C.G.)

23829 THE RADIOACTIVE STRONTIUM AND IODINE CONTENTS OF COW'S MILK. A REVIEW. W. G. Whittlestone (Univ. of Sydney). Australian J. Dairy Technol., 18: 209-15(Oct.-Dec. 1963).

The biological effects of radioactive fallout arise primarily from the ingestion of foodstuffs contaminated with active material. The greatest danger arises from those materials that are biologically concentrated. The Sr isotopes 89 and 90 and ^{131}I are the most serious as the former accompany Ca into the bone where they are concentrated and the latter is involved in the synthesis of thyroxine by the thyroid gland and so is concentrated in that organ at a high rate. With both Sr and I the rate of uptake and concentration is greatest in the growing child. Because of the importance of milk in the diet of the advanced countries it is a useful foodstuff on which to base estimates of the absorption of radioactive isotopes. The cow grazing over an extensive area collects a representative sample of isotopes of nutritional significance. Eighty-two percent of the Ca in our diet comes from milk and dairy products so that milk is the most important source of Ca and thus of Sr. Radioactive contamination of dairy products is discussed. (auth)

23830 ECONOMIC METHOD OF DECONTAMINATION OF CLOTHES AFTER CONTAMINATION WITH Ra^{226} AND ITS DISINTEGRATION PRODUCTS. M. Eysselt and J. Dohnalek. Cesk. Hyg., 8: 273-7(1963).

An account of experience with the decontamination of different types of fabrics (silk, cotton, woolen fabric, tweed, 50% wool synthetic fiber, handwoven wool and flannel) from traces of ^{226}Ra is given. According to the results obtained in two experiments, it is recommended to use for the decontamination watery solutions of: 2% solution of citric acid with 5% Eryphor added; and 2% solution of the Ca salt of ethylene diaminotetraacetic acid (EDTA). The textile is immersed in the first solution from 1 hr to 3 days depending on the degree of contamination and the type of fabric. The remainder of the solution is removed by rinsing in water. Subsequently the fabric is placed in the second solution from 1 hr to 2 days. Finally the fabric is rinsed and dried. The above procedure, using the two solutions, does not damage the color nor the fibers, it is inexpensive, and can be used when the contamination is not very extensive. Traces of ^{226}Ra are most readily removed from silk, cotton, tweed, knitted wool and flannel. Some other woolen fabrics require longer soaking in the solutions or the use of a brush. (auth)

23831 EXPOSURE DOSE BY DIAGNOSTIC X-RAY IN OBSTETRICS, AND SOME CONSIDERATIONS ON THE LOWERING OF SUCH DOSES. Akira Tabuchi, Toru Kawaishi, Masashi Hirata, Shigeru Nakagawa, Haruma Yoshinaga, Shigetoshi Antoku, and Tadashi Sunayashiki (Hiroshima Univ.). Hiroshima Igaku, 12: 57-69(Jan.-Feb. 1964). (In Japanese)

23832 A QUAKE AT BODEGA. Lindsay Mattison and Richard Daly. Nucl. Inform., 6: No. 5, 1-12(Apr. 1964).

The policies governing reactor safety are examined by reviewing certain past cases, and with this background, a single 315-Mw reactor in California now in the process of receiving official approval is examined. Termed the Bodega Bay Reactor, this installation is to be completed by 1966 and has been the subject of public controversy for several years. The experts seem to disagree and the public remains confused. Most of the questions of reactor safety heard in past controversies have been raised here, and one special safety question is involved, making Bodega a particularly important test of public policy concerning nuclear safety. (auth)

23833 STRONTIUM-90 CONTENT OF HUMAN BONES (1961—1963). Edward S. Weiss, William H. Land, Kenneth H. Falter, and Robert M. Hallisey. Radiol. Health Data, 5: No. 5, 231-9(May 1964).

Data are reported on the ^{90}Sr content of human bones collected between 1961 and Aug. 1963. The data are correlated with age and geographical region. The target population consisted of children and young adults up to 25 yr of age who were victims of accidents or acute disease processes that do not affect bone metabolism. In the age group below 4 yr, the average values of ^{90}Sr dropped from 1962 to 1963, while there was a slight increase in values above age 4. (C.H.)

23834 RADIOACTIVITY MEASUREMENTS IN ALASKAN ESKIMOS IN 1963. Harvey E. Palmer, Wayne C. Hanson, Bobby I. Griffin, and Dale M. Fleming (General Electric Co., Richland, Wash.). Science, 144: 859-60 (May 15, 1964). (HW-SA-3342)

During the summer of 1963 people at five villages above the Arctic Circle in Alaska were measured for accumulated radioactivity with a portable whole-body counter. Adults of the interior village of Anaktuvuk Pass showed the highest average body burden, 628 nanocuries of ^{137}Cs. This is an increase of nearly 50% over the summer before. The maximum burden found was 1.24 μC. (auth)

23835 METHOD FOR THE NEUTRALIZATION OF RADIOACTIVE SUBSTANCES. (to Joh. A. Benckiser GmbH). German Patent 1,162,695. Feb. 6, 1964. Filed Jan. 27, 1961.

A method is given for the neutralization of radioactive cesium or of isotopes combined with anions which adhere to commodities. The method comprises the steps of treating the commodities with solutions of polymeric phosphoric acids, citric acids, or tartaric acids, or the salts of the acids, of precipitating the isotopes contained in the solutions with a precipitant, for example whitewash, and of carrying out the final disposal of the radioactive precipitation. (Gmelin Inst.)

23836 MEANS FOR PURIFYING WASTE GASES.
Kurt R. Lessmann (to Ruhr Intrans Hubstapler GmbH).
U. S. Patent 3,132,192. May 5, 1964. Filed Sept. 1, 1960.

A device is designed for purifying exhaust gases of internal combustion engines. The device divides the exhaust gases into a multiplicity of small streams which strike the surface of a cleaning fluid at such a velocity that the cleaning fluid becomes turbulent, separating the heavier components of the exhaust from the gases. (D.L.C.)

INSTRUMENTATION

General

Refer also to abstract 23164.

23837 (CEA-R-2402) MESURE DE RESISTIVITE PAR LA METHODE D'INDUCTION EN COURANT CONTINU. (Resistivity Measurements Using a Direct Current Induction Method). J. Delaplace and J. Hillairet (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). Apr. 1964. 33p.

The conventional methods for measuring electrical resistivities necessitate the fixing of electrical contacts on the sample either mechanically or by soldering. Furthermore it is also necessary to carry out the measurements on low cross section samples which are not always easy to obtain. The described direct-current induction method on the other hand requires no contacts and can easily be applied to samples of large cross-section. The sample is placed in a uniform magnetic field; at the moment when the current is cut, eddy currents appear in the sample that tend to oppose the disappearance of the field. The way in which the magnetic flux decreases in the sample makes it possible to determine the resistivity of the material. This method was applied to samples having diameters of between 1 and 30 mm in the case of metals, which are good conductors. It gives a value for the local resistivity and makes it possible to detect any variation along a sample. The measurements can be carried out at all temperatures from a few degrees absolute to 500°C. The induction method was used to follow the purification of beryllium by zone-melting; it is in effect possible to estimate the purity of a material by resistivity measurements. The resistivity along each bar treated by the zone-melting technique was measured, and the purest section localized. High temperature measurements were carried out on uranium carbide and on iron–aluminium alloys. This method constitutes an interesting means of investigating the resistivity of solid materials. Its accuracy and rapidity make it particularly adapted both to fundamental research and to production control. (auth)

23838 (NP-13930(p.122-4)) AUFBAU UND WIRKUNGSWEISE EINES NEUTRONENREFRAKTOMETERS. (Construction and Manner of Operation of a Neutron Refractometer). L. Koester (Munich. Technische Hochschule).

For exact absolute measurements of coherent neutron scattering cross sections, a neutron refractometer was built. The reflector material and position in the refractometer are described. Principles of operation are discussed. (M.C.G.)

23839 (PAN-479/I) GENERAL-PURPOSE WINDOW AMPLIFIER. M. Nowicki and A. Turos (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Dec. 1963. 6p.

A simple window amplifier of great stability is described. This device has two thresholds that permit wide range adjustment. It amplifies linearly the part of pulses contained between levels of both thresholds. The maximum linear output of the amplifier is 110 v. The rise-time of the output pulse is less than 0.3 μs. (auth)

23840 (RT/ING(64)-2) DESCRIZIONE DI UN'ESPERIENZA PER PROVE DI IRRAGGIAMENTO SU TERMOCOPPIE. (Description of Experiment for Thermocouple Irradiation Tests). G. Bianchi and L. Matteuzzi (Italy. Comitato Nazionale per l'Energia Nucleare. Centro di Studi Nucleari, Casaccia). Jan. 1964. 13p.

A description is given of an apparatus designed for thermocouple irradiation tests in the Ispra-1 Reactor and determination of the modifications of the mv-temperature characteristic under the neutron-gamma irradiation effect. Numerical calculations concerning the mechanical, thermal, and nuclear design are given. (auth)

23841 (TID-20183) THE APPLICATION OF NUCLEAR TECHNIQUES TO THE MANUFACTURE OF HIGH-RELIABILITY PRINTED CIRCUIT BOARDS. I. J. Wright, J. B. Fishman, and C. E. Smedley (Tracerlab, Inc. Western Div., Richmond, Calif.). Dec. 1963. Contract AT(04-3)-434. 90p.

Certain process solutions leave undesirable residues, in the manufacture of printed circuit boards, which are below the level of detectability by conventional analytical techniques. The purpose of this investigation was to test the effects of some of these residues on circuit board reliability by radiotracer techniques, and further to show that these techniques could be used routinely on a production line. The use of radioactive tracers has been shown to be a valid technique for determination of the amounts of residual process contamination. Health and safety problems related to the use of such figures demonstrated to be minimal. It has been shown that process contamination from resist paint and ferric chloride etch, employed in circuit board manufacture at or near normal manufacturing levels, causes an increase in solder joint defects. This degradation of solder joint reliability can be detected and controlled by production-line use of radiotracers. The corrosion potential of boards fluxed with radioisotope tagged flux can be determined by an integrated count rate of the entire board surface. This investigation suggests that this method is the only nondestructive technique available for assuring the minimum corrosion potential of all boards manufactured. This method will also test all the individual circuit boards and gives results immediately, releasing the circuit board to production. (auth)

23842 (UCRL-9661) REMOTE PIPETTERS FOR USE IN HOT CELL ENCLOSURES. Edward S. Fleischer, A. Boyd Snyder, Thomas C. Parsons, and Patrick W. Howe (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 11, 1964. Contract W-7405-eng-48. 8p.

A method for remote pipetting that features precision and excellence of control is described. The operator and pipetter controller are generally separated from the box-enclosed mobile pipetter head by shielding that may be up to several feet in thickness. In the 6-ft Water-Cave Neutron Facility a Kollmorgen periscope is used in conjunction with one pipetter for taking samples in the range of 1 to 10 λ. Pipettes can be replaced remotely in the pipetter head by the box manipulators. Pipetter units with capacities 1 λ to ml and 1 λ to 5 ml, and also macro units with capacities up to 30 ml are in use. (auth)

23843 GENERATOR OF HIGH-POWER PULSES OF NANOSECOND LENGTH WITH STEEP FRONT AND ITS USE IN MEASURING MOBILITY OF ELECTRIC CHARGES IN GASES. J. Oravec and V. F. Sikolenko (Joint Inst. for Nuclear Research, Dubna, USSR). Czech. J. Phys., 14: 196-202(1964). (In Russian)

A generator of square-wave power pulses with a front of

2×10^{-8} sec and length of 0.6×10^{-6} sec for a capacity load of ~70 pF, with continuously regulable amplitude from 1 to 9 kv is described. The current in the pulses is >100 amp. The delay in the high-power pulse with respect to the triggering pulse does not exceed $(0.09$ to $0.15) \times 10^{-6}$ sec. The generator is intended for operating spark counters of relativistic particles although its range of use may be much greater. It use for studying the mobilities of electric charges in gas mixtures of spark counters is pointed out. (auth)

23844 A FAST-SLOW COINCIDENCE MATRIX SYSTEM. V. Caini and P. A. Tove (Uppsala Univ.). Energia Nucl. (Milan), 11: 186-91(Apr. 1964).

A fast-slow coincidence matrix circuit for obtaining two-fold fast coincidence combinations between 4 inputs and permitting input-amplitude-selected gating of the coincidences is described. It can be easily adapted to give 3- and 4-fold coincidence combinations. (auth)

23845 NUCLEAR TRACK PREPARATIONS FOR THE ELECTRON MICROSCOPE. G. Riedel (Kernforschungsanlage, Julich, Ger.). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 579-86(1963). (In German)

A method is described for applying extremely thin nuclear emulsion layers on labeled electron-microscopic preparations and measuring their thickness. Without separating them from one another, the preparation + emulsion; after exposure and development in the electron microscope, can be examined together. The beginning of the nuclear track could be identified exactly in this way and could be defined according to size and structure. This method can be used in aerosol research as well as for analysis of medical and biological sections. (tr-auth)

23846 AN ALPHA-PARTICLE VOLTMETER. L. H. Bettenhausen and W. J. Gallagher (Battelle Memorial Inst., Columbus, Ohio). Nucleonics, 22: No. 6, 70(June 1964).

The voltmeter measures the energy increment added to the "known" energy of alpha particles from a ^{210}Po source, as the alpha particles pass through the electric field produced by the voltage difference. The voltmeter can measure voltages in the 10^5 to 10^6 v range, and can operate in vacuum. (T.F.H.)

23847 A NUCLEAR EMULSION PLATE "SHUFFLER." S. Brinda, G. Greer, B. Thorness, and C. J. Waddington (Univ. of Minnesota, Minneapolis). Nuovo Cimento (10), 32: 212-17(Apr. 1, 1964).

Details are given of a device in which selected emulsions in a stack of stripped emulsions may be moved on demand. In this device all the advantages of an emulsion stack are retained and yet a unique separation of particles arriving before or after a given time is also provided. (auth)

23848 SPACE-CHARGE FAST WAVE NOISE REMOVAL BY MEANS OF RESONATOR. V. M. Lopukhin and A. S. Roshal (Moscow State Univ.). Radiotekhn. i Elektron., 9: 241-51(Feb. 1964). (In Russian)

A one-dimensional single velocity approximation was developed for electron noise propagation with a given spectral density matrix in a resonator with a homogeneous longitudinal field. Numerical calculations showed that an effective reduction of the mean square amplitude of fast space-charge waves by means of a suitable resonator is possible. An amplification of fast wave noise is also possible due to fast and slow wave noise bonding in the resonator field. The influence of various flux and resonator parameters on the noise selection process was analyzed. (tr-auth)

23849 DATA PROCESSING. R. L. Chase (Brookhaven National Lab., Upton, N. Y.). p.275-7 of "Nuclear Electronics." Paris, ENEA, 1964.

Data processing problems in nuclear physics are discussed. Electronic computers and pulse-height analyzers are considered. (R.E.U.)

23850 SOME APPLICATIONS OF MICROLOGIC ELEMENTS IN NUCLEAR INSTRUMENTATION. W. D. Howell (Atomic Energy of Canada, Ltd., Chalk River, Ont.). p.279-89 of "Nuclear Electronics." Paris, ENEA, 1964.

Micrologic elements were applied to a number of circuits encountered in nuclear physics instrumentation. The micrologic elements employ direct-coupled-transistor logic, and five standard configurations produced by Fairchild were used. These elements were incorporated in a family of counting circuits that demonstrate both the simplicity of the approach and the reduction in design time required. Starting with four binary flip-flop stages and employing the appropriate intercoupling logic, the following counting circuits have been developed: (a) A scale of 16 counters using 13 micrologic elements with an input resolution of 0.2 μs. (b) A binary coded decimal scale of 10, using 16 micrologic elements with a resolution of 0.5 μs. (c) A binary coded decimal scale of 10, using 18 micrologic elements with a resolution of 0.15 μs. (d) A reversible scale of 16, using 24 micrologic elements with a resolution of 0.25 μs. (e) A reversible scale of 10, using 28 micrologic elements with a resolution of 0.25 μs. (auth)

23851 A SLIDING SCALE ANALOGUE TO DIGITAL CONVERTER FOR PULSE ANALYSIS. C. Cottini, E. Gatti, and V. Svelto (Laboratori CISE, Milan). p.309-12 of "Nuclear Electronics." Paris, ENEA, 1964.

A new method of fast analog-to-digital conversion, applicable to different types of converters, is shown. A particular application of the principle to a feedback coding system is illustrated, and the performance of the instrument is discussed. As it is well known in all coding systems, except the serial one of the Wilkinson type, the differential linearity that is the equality of the width of the channels, is a major problem. In particular the difficulty of solving this problem, due to the fact that the boundaries of the channels are not defined by a single physical element, has prevented the widespread use of the parallel fast coding. The suggested method is based on the principle of classifying the pulses in a definite amplitude range, not always with the same procedure, which implies always the same boundaries, but with a set of different procedures in order to imply statistically the use of different boundaries. The method is the electronic version of the mechanical operation of classifying a set of objects according to their length in length channels by the use of a not ideal graduated rod. The operator can compensate, by averaging, the unequal length intervals by using, for the measurement of the objects, each time at random, a different part of the rod instead of starting always from the origin of the scale. (auth)

23852 LINEAR GATE AND FAST PULSE HEIGHT CODING SYSTEM. V. Goursky and H. Guillon (CEN, Saclay, France). p.313-24 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

The amplitude-to-time converter described is intended for use in pulse-height or multi-parameter analyzers. The principal characteristics required are very high accuracy and a speed of operation of similar order. The principle of operation is classical, being based on the linear discharge of a capacitor; however, an improvement allows the simultaneous analysis of two bands of the same spectrum, with different resolutions if desired. In front of the converter is a linear gate of approximately the same quality, which has an original circuit. (auth)

23853 TRANSISTORIZED MAGNETIC-TAPE RECORDING AND READING UNIT. Ch. Hugot and P. Malaval (CEN, Saclay, France). p.401-8 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

This unit is intended to be used as the main memory in a nuclear physics experiment where events have been coded in numerical form. The magnetic-tape unit has 16-track recording and reading heads, and operates at six speeds between 2.5 cm/s and 3 m/s. The electronic recording and reading equipment (NRZ1 numerical recording) ensures the removal of erroneous events by parity detection and, in addition, a simultaneous check of the recording is provided by signal take-off at the reading heads. Special care was taken to reduce manual operations on the part of the user. For example, the tape-speed remote control automatically adjusts the gain of the reader amplifiers and the recording frequency (constant density of 8 bits/mm). Tests conducted over a period of three years with different tape units and magnetic tapes have resulted in a high standard of reliability and a relatively low nondetected-error rate (10^{-6}). (auth)

23854 TRANSISTORIZED BUFFER MEMORY. A. Boucherie (CEN, Saclay, France). p.409-15 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

This memory is chiefly intended to regularize the flow of coded data arriving at random intervals of time, for recording in a magnetic-tape memory. It comprises ten registers, each capable of storing sixteen binary digits, and there is provision for an additional twelve registers for the sequential recording of words of more than sixteen digits. Its resolving time is one μsec. The memory elements consist of bistable circuits with associated transistors of inexpensive widely used types. (auth)

23855 FOUR-CHANNEL DIGITAL COMMUTATOR. A. Pages, M. Avril, and M. Vidal (CEN, Saclay, France). p.417-26 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

The unit switches digital data in parallel pure binary code from four independent channels to a common output. Advantages and disadvantages are discussed. (auth)

23856 PULSE-HEIGHT ANALYSIS ACCURACY AT HIGH RATES. B. Soucek (Inst. "Ruder Boskovic," Zagreb). p.437-41 of "Nuclear Electronics." Paris, ENEA, 1964.

The general problem of different pulse shapes of linear networks is considered in connection with the pile-up of pulses. It is shown that in many cases the magnitudes added to the measured pulses have approximately γ distribution whose parameters depend on the pulse shapes, input rate, and amplitude distribution. The theoretically obtained response of measurement systems for random input events having a Gaussian amplitude distribution or having a constant amplitude is confirmed by the experiments. The results can be used for the estimation of the distribution measurement accuracy of practical systems. (auth)

23857 SINGLE PHOTOELECTRON PULSE SPECTRA AND PHOTOMULTIPLIER BACKGROUND NOISE. M. Duquesne and I. Tatischeff-Kaplan (Institut du Radium, Paris). p.443-9 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

The observation of single photoelectron pulse spectra with a luminous signal of low intensity, the difference between amplitude distributions for signal and background noise, the influence of temperature, of the high voltage applied, and of the potential of external shielding, on the background noise, and the best conditions for detecting weak light flux are discussed. (auth)

23858 EXPERIENCE WITH AN ON-LINE COMPUTER FOR NUCLEAR PHYSICS EXPERIMENTS. J. Leng and A. Pearson (Atomic Energy of Canada, Ltd., Chalk River, Ont.). p.519-31 of "Nuclear Electronics." Paris, ENEA, 1964.

The pulse counting and analyzing facility associated with the 5-Mev Tandem Van de Graaff accelerator at Chalk River was integrated with a high speed digital computer. The contents of one 900-channel and two 100-channel pulse-height analyzers, together with digits of scaler and switch information, can be transferred directly by electrical connection to the computer memory. Up to 3,300 words of the computer's 8,192 word memory can be used for this purpose. Other memory space is devoted to editing information and storage of programs for subsequent analyses. With these programs spectra can be displayed on an oscilloscope in the scale and format required, and energy calibration numbers can be entered so that each channel relates to a particular energy. A light-pen selecting any channel on the display will invoke a numerical display of the channel number together with its energy. Area integration can be performed using the light pen to indicate limits, the complete routine taking less than a millisecond, after initiation, for a 10-channel peak. When performing spectrum stripping operations, two 100-channel spectra can be subtracted in 3 msec. For multiparameter analysis, up to eight pulse-height encoders feed digitized data directly to the computer for entry in the memory. The computer performs other operations during this type of work; an encoder simply interrupts the current program and goes to a subroutine for adding an event to a word in memory, after which it reverts to the previous program. When performing coincidence analysis using two encoders, the analysis and storage of an event, including the operations of leaving and reentering the main program, is performed in 265 μsec. (auth)

23859 MULTICHANNEL ANALYSIS BY USE OF AN ON-LINE COMPUTER. G. Krueger and G. Dimmler (Kernforschungszentrum, Karlsruhe, Ger.). p.533-8 of "Nuclear Electronics." Paris, ENEA, 1964.

A CDC 160-A computer (8K core memory storage, 12 bit word length, 6.4 μsec memory cycle) and a CDC 603 magnetic tape unit are used for multichannel, multidimensional analysis. Along with the standard equipment, a special input unit and a display unit were designed and built. The input unit is used to transfer the data of several independent neutron capture γ-ray and time-of-flight experiments to the computer. The data are checked and reduced in the computer and then written on magnetic tape so the data may be further processed after the completion of the experiments. A selected part of the incoming data is summed up in 4,000 channels and may be displayed on the screens of the display units. The display units have two principle modes: if the experiments are running, the computer transfers the data for display by a buffer routine as an endless loop, without interrupting the main program. To save time only one channel of data (e.g., the contents of the channel that should be displayed) will be given for each point, while the x- and y-coordinates will be generated by the display unit. In the normal case one screen displays the map pattern and on the other screen selected single spectra may be examined. If the computer works without incoming data, there are many possibilities for display pattern, such as a map display, isometric display, etc. The design of the whole data processing system is described and some experiences are discussed. (auth)

23860 AN INTEGRATED COMPUTER-ANALYZER SYSTEM FOR REAL-TIME REDUCTION OF MULTIPARAMETER DATA. W. W. Eidson and J. G. Cramer, Jr. (Indiana Univ., Bloomington). p.539-46 of "Nuclear Electronics." Paris, ENEA, 1964.

Experimental techniques in nuclear physics have now reached a level of sophistication where rapid strides can be made toward resolution of the basic problems of nuclear structure and interactions. However, as a consequence of this increased experimental sophistication and complexity, the experimenter is faced with two basic and perplexing problems; firstly, how can all of the information which can be derived from an experiment be obtained in the most efficient way, and secondly, how can these data be handled and reduced in a reasonable amount of time to a form that can be readily comprehended and interpreted by the experimenter? A flexible, comprehensive, and efficient solution to both of these problems is presented in the form of an integrated instrumentation and data handling facility. While this facility can, in principle, be used with any accelerator installation and in a wide variety of experimental applications, it will be discussed in the context of use with the Indiana University Cyclotron. The analog-digital computer-display system was designed on the basis of considerations concerning the proper functions of the idealized multiparameter analysis (MPA) system. It was decided that the "ideal" MPA system should be capable of: accepting data from a variety of input channels simultaneously, and digitizing the data in a time that is short compared to the data storage speed of the system; reducing and condensing incoming data immediately (in real operating time) and rejecting unwanted events in a time period comparable to the data storage speed of the system; storing raw and/or reduced data in a large volume memory at a speed that is comparable to the maximum anticipated counting rate of the experiment. Displaying accumulated data in convenient form as it comes in, so that the progress of the experiment can be monitored and the operation of the experimental apparatus can be checked. This function should not interfere with the functions given above and, preferably, should involve no time-sharing with the data reduction function; further reduction and reanalysis of accumulated data off-line when the experiment is completed and time is available; producing output records of the raw, reduced, and analyzed data in forms convenient for further computation and analysis, and for interpretation and evaluation by the experimenter. The designed facility consists of an eight-parameter analog-to-digital converter (12 bit, 100 kH$_z$); a fast, medium-size computer; independent, live display; readout devices; and input amplifiers, coincidence circuits, and time-to-pulse-height converters. The designed instrumentation and data handling facility meets most of the specifications and comes close to meeting the others. (auth)

23861 LABORATORY MEASURING-REGISTERING CENTER. I. V. Shtranikh, V. N. Bochkarev, A. N. Volkov, V. M. Geraseev, A. M. Klabukov, V. V. Puzanov, and A. M. Shimanskii. p.587-600 of "Nuclear Electronics." Paris, ENEA, 1964.

The structure of a center, which is intended to provide a centralized service for several physics groups of a nuclear laboratory engaged in work connected with a multichannel spectroscope, is considered. The center has more than 10,000 channels and is being constructed on the basis of the main standard equipment of a typical electronic computer (magnetic drum, typewriter, card punch, reading device). The input parameters are coded. A buffer memory of the "flattening" (derandomizer) type that operates with re-recording of the read code is used to increase the rapidity of operation of the registering chains. Carrying out of simple arithmetical operations with channel numbers is specified (addition or subtraction with any factor, etc.). (auth)

23862 THIN-FILM FAST MAGNETIC MEMORIES: THEIR APPLICATIONS IN NUCLEONICS. B. Alexandre, G. Antier, and G. Grunberg (CEA, Paris). p.657-65 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

In the race towards high frequencies, which is a feature of electronics today, the use of ferromagnetic materials is mainly limited by the losses due to the induced currents. At the frequencies used in industry where this problem is already encountered, such losses are reduced by using materials of higher resistivity (Fe–Si alloy) and by using thinner laminations. These ideas still hold true at higher frequencies and have led to the discovery of ferrites ($\rho = 10^7\ \Omega$/cm), and the use of very thin ferromagnetic films (about 1,000 Å). The interest being shown in these materials is not only on account of the low losses, which is an essential condition for the use of thin films at high speeds. It is shown that the two-dimensional geometry endows such devices with a number of noteworthy magnetic properties, which, especially in memory applications, make it possible to achieve better performances than those obtainable with ferrites. After referring to the processes used for storing binary data in a thin-film memory, the characteristics of a memory capable of storing sixteen words of sixteen digits each, which has a 200 nsec. working cycle, and the possibility of extending this principle to much larger capacities are discussed. An example of the possible use of such a memory in a nuclear physics experiments is given. (auth)

23863 ON TWO FAST TUNNEL DIODE MONOSTABLE MULTIVIBRATOR CIRCUITS AND A FAST LINEAR TRANSMISSION GATE. H. Verweij (CERN, Geneva). p.723-30 of "Nuclear Electronics." Paris, ENEA, 1964.

Two high-speed trigger circuits are described, basically consisting of a tunnel diode, a backward diode, and a grounded base transistor. One version is with an inductance, the other with a capacitance as a memory element. The amplitude of the output pulse can be any desired fraction of the peak minus valley current. The linear transmission gate operates over a range from 0.1 to 10 v. Base and signal feedthrough are very small. Rise and fall time ≈ 2 nsec. A version for positive and one for negative signals is discussed. Both instruments work up to 100 MHz pulse repetition rate. (auth)

23864 SEMICONDUCTOR, LOW RESOLUTION TIME COUNTERS. J. P. Duchemin (CEA, Paris). p.755-60 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

Two transistorized tunnel-diode counters are described, each being capable of discrimination, pulse shaping, gating, and counting. One of them counts decimally from a binary base and has a resolution time of 10 nsec. for a train of 10 pulses. The other counts on the binary system and has a resolution time of 5 nsec. The instruments are constructed as plug-in units for use in racks. (auth)

23865 RADIOACTIVE TRACER STUDY OF A PHOTOMULTIPLIER MANUFACTURING PROCESS. J. G. Koosman. 14p. (CONF-182-14).

From 9th Scintillation and Semiconductor Counter Symposium, Washington, D. C., Feb. 1964.

A quantitative measurement of the cesium disposition within a multiplier phototube was accomplished by the use of cesium-137 as a tracer. The processing and measurement techniques are described, and the significance of the findings are discussed in relation to tube performance and improvement. An attempt was made to examine the role of cesium in the fatigue behavior of the AgMgOCs dynode surface. The effort met with interpretation difficulties when it was found that an apparent excess of cesium masks the postulated surface changes. Experimental work with the Du Mont 6292 showed that a low fatigue rate is associated with a high degree of dynode oxidation, but no correlation with cesium uptake was readily evident. (auth)

23866 IMPROVEMENTS IN OR RELATING TO MEASURING DEVICES. (to Philips Electrical Industries Ltd.). British Patent 956,727. Apr. 29, 1964. Priority date Nov. 26, 1959, Germany.

A β-ray device to measure the thickness of work pieces is patented. The work pieces, e.g. wafers of semiconductor material, are placed in recesses in a conveyor belt. The absorption thickness of the conveyor belt is chosen to be ~ equal to that of the items being measured so that a fairly constant current is maintained in the measuring counter. The conveyor belt passes between a β-ray source and one of two proportional-flow counters connected in parallel to a common supply of methane gas. The gas-flow resistances of the counters must differ by less than 20% and may be determined by capillary tubes connected to the counter tubes. The counters use a common voltage source and are electrically connected to provide a continuous reading representing the difference in absorption measured by the counters. (M.P.G.)

23867 IMPROVEMENTS IN OR RELATING TO LIQUID-PRESSURE REGULATING DEVICES. Louis Berthod and Michel Grenon (to Commissariat à l'Energie Atomique). British Patent 957,472. May 6, 1964. Priority date Apr. 29, 1960, France.

A pressure-regulating device, which responds rapidly to variations in pressure, is patented. Conventional pressure-regulating devices for hydraulic circuits consist of a tank connected to the circuit containing the hydraulic liquid at saturation temperature. Pressure is regulated by evaporation or condensation of the liquid, but condensation does not occur rapidly enough to prevent high momentary excess pressure. The patented pressure regulator utilizes the conventional device but provides 2 entrances into the tank from the hydraulic circuit, one above the maximum level reached by the liquid in the tank and the other below the minimum level. The upper entrance is equipped with a nozzle, jet deflectors, and grids to expedite condensation, and the entrances are designed so that more of the liquid flows through the nozzle than through the lower entrance. The pressure regulator is particularly useful in mobile installations such as propulsive reactors. (M.P.G.)

23868 NEUTRON SLOWING DOWN AND ABSORPTION LOGGING METHOD. Stanley B. Jones, Delmar O. Seevers, and Walter E. Meyerhof (to California Research Corp.). U. S. Patent 3,133,195. May 12, 1964. Filed Dec. 5, 1958.

A neutron well logging method and an apparatus are described for measuring the hydrogen concentration and the concentration of chlorine or other elements of large thermal neutron cross sections in an earth formation. In the method, the fast neutron flux is cyclically varied, and the buildup and decay of the epithermal and thermal neutrons and gamma rays are measured as a function of time. The advantage of the method is that frequent calibration of the equipment is no longer necessary. (D.L.C.)

23869 ENHANCED POLARIZATION NUCLEAR FREE PRECESSION MAGNETOMETER. Georges Bonnet, Jean Louis Laffon, and Pierre Servoz-Gavin (to Commissariat a l'Energie Atomique). U. S. Patent 3,133,243. May 12, 1964. Priority date July 18, 1960, France.

A nuclear induction magnetometer is designed for measuring weak magnetic fields, such as the earth's magnetic field, by means of the Overhauser-Abragram effect. A solution containing atomic nuclei of a gyromagnetic ratio different from zero and paramagnetic ions of an electronic resonance line different from zero in zero field, is placed in a h-f alternating field and an auxiliary magnetic field at an angle to the field to be measured. The auxiliary field is quickly cut off, and the precession frequency of the atomic nuclei is measured as a measure of the field to be measured. The duration of the application of the auxiliary magnetic field is of the order of magnitude of the Larmor period, and a large number of measurements per minute may be made. (D.L.C.)

Radiation Detection

Refer also to abstracts 23390, 23807, 23818, 24822, 24839, and 24840.

23870 (AERE-R-4380) A GRAPHICAL AID TO FOCUSING A TRIPLE-AXIS SPECTROMETER. G. Peckham (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Apr. 1964. 13p.

A graphical method is developed for finding an arrangement of the sample and spectrometer that will give a narrow peak in the energy spectrum of the inelastically scattered neutrons. The focusing diagram can be used to select the best arrangement for observing the scattering due to a particular phonon. (D.C.W.)

23871 (ANL-6822) FOIL ACTIVATION PROGRAMS, B512/RP. E. M. Pennington and W. L. Boettinger (Argonne National Lab., Ill.). Jan. 1964. Contract W-31-109-eng-38. 96p.

Programs were written in Fortran for the IBM-704, which calculate cutoff-energy values and various activation integrals for foils in slab geometry. Both the absorbing foil and the covers are of arbitrary thicknesses, and have absorption cross sections consisting of a 1/v part and/or Breit-Wigner resonances. The angular dependence of the neutron flux is either isotropic or beam, whereas the energy dependence is either Maxwellian with several epithermal options or of a flux input for a suitable number of energy values. (auth)

23872 (BNL-833) STEAM: A COMPUTER PROGRAM TO ANALYZE SPARK CHAMBER DATA OBTAINED BY USE OF AN AUTOMATIC FLYING SPOT DIGITIZER. S. Heller, L. Padwa, and I. Perlman (Brookhaven National Lab., Upton, N. Y.). Dec. 1963. Contract AT-30-2-GEN-16. 27p.

The programs STEAM for processing spark chamber film data produced by a digitizer is described, together with the digitizer and the experiment ($K^{\pm}$ – p elastic scattering) for which the system was originally developed. (D.C.W.)

23873 (HW-80798) AUTOMATIC SAMPLE CHANGER FOR GAMMA SCINTILLATION WELL DETECTOR. W. H. Zimmer (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 1964. Contract AT(45-1)-1350. 18p.

An automatic sample changer is described that accepts samples from a gravity fed magazine and delivers them to a well scintillation detector for analysis. After analysis, the samples are removed from the detector and delivered to waste. Both the sample magazine and the waste container are far removed from the detector to avoid radiation interference. All sample transfers are pneumatic and are sequenced and controlled by a changer mechanism. (auth)

23874 (JINR-P-1619) IZOTROPNAYA RAZRYADNAYA KAMERA DLYA REGISTRATSII TREKOV RELYATIVISTSKIKH ZARYAZHENNYKH CHASTITS. (An Isotropic Discharge Chamber for Detecting the Tracks of Relativistic Charged Particles). M. M. Butslov, V. I. Somarov, and O. V. Savchenko (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1964. 16p.

An isotropic discharge chamber with a fiducial volume of about 500 cm^3 is described. This chamber allows the detection of the tracks of relativistic charged particles regardless of the angle between the particle trajectory and the direction of the pulsed electric field. The operating characteristics of the chamber were measured for pure inert gases (neon, helium) and for contaminants (methane, alcohol, water, etc.) at pressures of 0.25–1.0 atm. The results are presented. (auth)

23875 (K-1586) A PORTABLE NEUTRON COUNTER FOR DETERMINING WEIGHTS OF DEPOSITS OF URANIUM–FLUORINE COMPOUNDS. R. H. Stevens and R. C. Smith (Oak Ridge Gaseous Diffusion Plant, Tenn.). May 11, 1964. Contract W-7405-eng-26. 29p.

A high-sensitivity, portable fast neutron counter was developed for determining the weights of solid accumulations of uranium-fluorine compounds in closed process equipment. The instrument is sensitive to neutron flux as low as 0.005 n/cm^2/sec, which is about 0.02% of the maximum permissible fast neutron dose rate for man. The neutron flux from the deposits in plant equipment results from the reaction between alpha particles emitted by decaying uranium and fluorine nuclei, and is thus a function of the amount of uranium present. Although special techniques are necessary for the evaluation of the data obtained with the neutron counter, results are more reliable than those depending on measurements of gamma radiation intensities, which are seriously affected by the shielding effects of process equipment, self-absorption of thick uranium deposits, and by the presence of uranium daughter products. The neutron counter consists of a moderated boron trifluoride-filled ionization chamber probe and a battery powered scaling unit interconnected by a 35 foot cable. The instrument will operate five to eleven hours, depending on the counting rate, before battery recharging is necessary. The construction of the instrument, the techniques used in monitoring deposits, and the evaluation of neutron count data to obtain weight estimates are described. (auth)

23876 (KFK-180) DETERMINATION OF ABSOLUTE THERMAL NEUTRON FLUX BY GOLD FOILS. W. Poenitz (Kernforschungszentrum. Institut für Angewandte Kernphysik, Karlsruhe, Germany). Apr. 1963. 28p.

A relation for the activation rate of a gold foil is discussed, together with the necessary corrections. The method used for absolute determination of ^{198}Au activity at Karlsruhe is then discussed. The effective beta self absorption factor was determined by two techniques involving $4\pi\ \beta-\gamma$ coincidence counting. The necessary corrections are established and evaluated. The two methods gave results in good agreement. Using the self absorption factors, the ^{198}Au activities can be determined by $4\pi\ \beta$-measurements with an accuracy of 0.2 to 0.3%. The absolute thermal neutron flux determination should be accurate to 0.5%. (D.C.W.)

23877 (NIRL/M/38) A KINEMATICAL FITTING PROGRAM FOR THE ANALYSIS OF BUBBLE CHAMBER EVENTS. A. G. Wilson (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Chilton, Berks, England). July 1962. 32p.

A program for IBM 7090 is described to carry out kinematical fitting of bubble chamber events. It is intended to be as general as possible, and will fit variables at several interaction vertices simultaneously. A method is introduced to allow the variables, which are being fitted, to be specified at the centers of tracks, where it is hoped the errors will have a normal distribution. The final output will consist of the characteristic two angles and a momentum for each track, with errors, specified at interaction vertices. Desired physical quantities can then be calculated from these. (auth)

23878 (NP-13930(p.76-7)) VERGLEICH KOHÄRENTER STREULÄNGEN AM NEUTRONENINTERFEROMETER. (Comparison of Coherent Scattering Lengths on a Neutron Interferometer). J. Landkammer (Munich. Technische Hochschule).

The coherent neutron scattering lengths of aluminum and bismuth were compared using an interferometer. The accuracy obtainable by this method amounted to 2.5 × 10^{-4}. (M.C.G.)

23879 (NP-13930(p.126)) EIN DREHKRISTALLSPEKTROMETER FUR STREUEXPERIMENTE MIT LANGSAMEN NEUTRONEN. (A Rotating Crystal Spectrometer for Scattering Experiments with Slow Neutrons). H. Ripfel and G. Ehret (Kernforschungszentrum, Karlsruhe, Germany).

An instrument consisting of a rotating single crystal for production of one or more pulsed monoenergetic beams from a reactor beam for measurements of scattering of neutrons between 5 × 10^{-3} and 5 × 10^{-1} ev is described. (M.C.G.)

23880 (NP-13930(p.127)) UNTERDRÜCKUNG VON REFLEXIONEN HÖHERER ORDNUNG IN EINEM ROTIERENDEN KRISTALLSPEKTROMETER MITTELS EINES MECHANISCHEN VORSELEKTORS. (Suppression of Reflections of Higher Orders in a Rotating Crystal Spectrometer by Means of a Mechanical Preselector). G. Quittner (Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf, Austria).

A mechanical preselector, built according to the principle of N. Holt, was used for suppressing reflections of higher orders in a rotating-crystal spectrometer. Background reduction and neutrons of a certain energy range are necessary for use of a preselector. (M.C.G.)

23881 (NP-13930(p.128-9)) EIN PRÄZISIONSKRISTALLSPEKTROMETER FUR LANGSAME NEUTRONEN. (A Precision Crystal Spectrometer for Slow Neutrons). E. Albold (Kernforschungszentrum, Karlsruhe, Germany).

A precision crystal spectrometer was designed for measuring monoenergetic neutrons of the thermal region. The design, operation principles, and efficiency of the spectrometer are discussed. (M.C.G.)

23882 (NP-13930(p.144-6)) EIN FLUGZEITSPEKTROMETER FUR SCHNELLE NEUTRONEN. (A Time-of-Flight Spectrometer for Fast Neutrons). R. H. Siemssen, M. Cosack, R. Felst, and S. Skorka (Germany. Physikalisches Staatsinstitut, Hamburg).

A time-of-flight spectrometer for fast neutrons on the Hamburg 3-Mev Van de Graaff, that uses an external beam pulsing, is described. Ways of obtaining short pulse times, neutron detection methods, and amplitude spectra analysis are discussed. A diagram is included. (M.C.G.)

23883 (NP-13930(p.147-57)) RUCKSTOSSPROTONENSPEKTROMETER ZUR AUSMESSUNG SCHNELLER NEUTRONENSPEKTREN. (Backscattering Proton Spectrometer for Measuring Fast Neutron Spectra). E. Bagge, W. Franke, and M. Greim (Gesellschaft für Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht, Germany).

Neutrons were scattered by hydrogen-containing films. The scattering can be assumed to be purely elastic to neutron energies of about 10 Mev. By measurement of the energy spectrum of the protons under a solid scattering angle Θ, the energy spectrum of the neutrons could be determined. The measuring arrangement for determination of the Geesthacht Research Reactor fast neutron spectra is shown. A polyethylene film was used. A proportional detector was used for analysis of proton energies. Results of measurements are shown on graphs. (M.C.G.)

23884 (NP-13930(p.159-77)) SPEKTROMETRIE SCHNELLER NEUTRONEN MIT HALBLEITERN. (Spectrometry of Fast Neutrons with Semiconductors). J. Moritz (Gesellschaft für Kernenergieverwetung in Schiffbau und Schiffahrt m.b.H., Geesthacht, Germany).

The use of semiconductor detectors for neutron spectrometry is discussed. A thin ^{6}LiF layer was evaporated on the counting surface of a semiconductor detector with satisfactory resolution. A second detector with comparable resolution and the same size counting surface was joined to it with some small conducting silver drops on the rim of the crystal platelet, so that between the two detectors only the thickness of an air layer such as was necessary to supply the work potential of the counter surface of the detector with a 0.1-mm Θ fine gold wire was present. Diagrams are shown. Graphs of pulse height distribution, total spectra, calibration spectra, and other measurements are included. (M.C.G.)

23885 (NP-13930(p.178-80)) SCHWELLWERTDETEKTOREN ZUR AUSMESSUNG SCHNELLER NEUTRONENFLUSSE. (Threshold Detectors for Measurement of Fast Neutron Fluxes). L. Greim (Gesellschaft für Kernenergieverwertung in Schiffbau and Schiffahrt m.b.H., Geesthacht, Germany).

The threshold detectors sensitive to fast neutrons were used as activation samples. Nuclear reactions of the types (n,p), (n,α), etc., that led to radioisotopes were considered. The induced activity was a measure of the neutron radiation. Materials used included: ^{27}Al, ^{58}Ni, ^{32}S, and ^{31}P. (M.C.G.)

23886 (NP-13965) ISSLEDOVANIE SOSTEVA RUTENIYA-103 I RUTENIYA-106 V SMESI PRODUKTOV DELENIYA METODOM BETA GAMMA-SOVPADENII STSINTILLYATSIONNYKH SPEKTROMETROV. (Investigation of Ruthenium-103 and Ruthenium-106 Content in a Mixture of Fission Products by the Method of Beta-Gamma-Coincidence in Scintillation Spectrometers). Z. G. Gritschenke (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'Zovaniyu Atomnoi Energii). 1963. 20p.

A $\beta-\gamma$ coincidence device was used for determining the contents of ^{106}Ru in mixtures of fission products 20 and more days old without preliminary radiochemical purification. The sensitivity of the method is 10^{-10} C against the high background activity of other fission products. The block scheme of the device is given, and it is shown that with certain modifications it can be used for determining the isotopic contents of other isotopes (^{95}Zr, ^{95}Nb, ^{141}Ce, and ^{144}Ce). (R.V.J.)

23887 (PAN-474/VI) SIUP—A SIMPLE GEOMETRICAL RECONSTRUCTION PROGRAM. M. Bardadin, L. Michejda, A. Otwinowski, and R. Sosnowski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Nov. 1963. 26p.

The geometrical reconstruction program, SIUP, used by the Warsaw bubble chamber group is described. Its input data consist of only the necessary minimum of information in order to simplify the measurements and calculations. The data consist of x- and y-coordinates measured on three stereoviews for two fiducial marks, characteristic points, and points on the tracks. For each track only three points per stereoview are measured. One of them is an apex common for all tracks of the star. Two other points are taken from the middle and the end of the track. They do not have to be "corresponding" points on the different stereoviews. SIUP provides the coordinates of the apices of the stars, the coordinates of the corresponding points, and the momentum vectors for the tracks. For each of the tracks a parameter defining the goodness of measurements is given. The results of the reconstruction of the high energy π^- interactions in the 81-cm Saclay H.B.C. are presented. (auth)

23888 (PWAC-424) LCRE NEUTRON SENSOR DEVELOPMENT PROGRAM. R. C. Harrison (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Mar. 23, 1964. Contract AT(30-1)-2789. 50p.

Long term temperature tests were conducted in the CANEL temperature test rig on high temperature Reuter-Stokes neutron sensors to determine the degree of insulator and seal degradation with time and temperature. The operating characteristics of the sensors were determined by monitoring the CANEL critical assemblies during the tests. After 8910 and 7630 hours at 400°F, no degradation was observed. Reactor irradiation tests were also performed on four ion chambers and four fission counters at the Battelle Research Reactor. All units operated satisfactorily at the conclusion of the 2200-hour test. The maximum radiation dose received by the sensors was 9.4×10^{16} nvt thermal, 5.9×10^{18} nvt fast (>1 Mev), and 3.6×10^{11} erg/gm. The temperature and irradiation tests were extended to 10,000 hours. Some results are reported. (L.B.S.)

23889 (RT/EL(64)-1) MONITORE DI INTENSITA DI DOSE DI ESPOSIZIONE. (Monitor for Exposure Dose Intensity). G. Caserta, C. Cochi, and F. Fioroni (Italy. Comitato Nazionale per l'Energia Nucleare. Centro di Studi Nucleari, Casaccia). Jan. 1964. 19p.

An electronic measuring assembly, with optical and audio alarms is described to be used for measuring the radiation dose intensity in work areas. (C.H.)

23890 (SCPRI(S)-92) LOCALISATION DES ZONES ACTIVEES CONSECUTIVES A L'EXPOSITION A UN HAUT FLUX DE NEUTRONS CHEZ LE RAT—METHODE PRATIQUE DE DETERMINATION DES DOSES ABSORBEES EN NEUTRONS THERMIQUES ET EN NEUTRONS RAPIDES. (Localization of Consecutive Activated Zones After Exposure to a High Neutron Flux in the Case of the Rat—Practical Method for Determination of Absorbed Doses of Thermal and Fast Neutrons). J. Chanteur, P. Pellerin, and Y. Arnaud (France. Service Central de Protection contre les Rayonnements Ionisants, Paris). [1963]. 11p. (CONF-205-13)

From International Atomic Energy Agency Symposium on the Biological Effects of Neutron Irradiations, Upton, N. Y., Oct. 1963.

An autoradiographic study of the localization of activated zones in rats exposed to a thermal neutron flux established the relative importance of ^{32}P among the activation products in bone. The results also show that the absorbed doses of thermal and fast neutrons can be determined by measuring the induced ^{32}P and ^{31}Si activities, respectively. The threshold doses for measurements by the two activations are 0.6 and 2.0 rad, respectively. (D.C.W.)

23891 (UCRL-11339) A 709/7090 FORTRAN II PROGRAM TO COMPUTE THE NEUTRON-DETECTION EFFICIENCY OF PLASTIC SCINTILLATOR FOR NEUTRON ENERGIES FROM 1 TO 300 Mev. Richard J. Kurz (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 18, 1964. Contract W-7405-eng-48. 34p.

The computer program TOTEFF, in FORTRAN II for the IBM 709/7090, is described. All known systematics for n-C and n-p interactions were used in this analysis. First- and second-scattering contributions from interactions with both protons and carbon, saturation effects in the production of scintillation light, and finite resolution of the detector threshold are included. The calculation is outlined, and sample results are presented and compared with experimental data. Source-program listings and cross section data are also included. (D.C.W.)

23892 (USNRDL-TR-729) AN AUTOMATED FAST COINCIDENCE NUCLEAR RADIATION SPECTROMETER. J. P. Hurley (Naval Radiological Defense Lab., San Francisco). Mar. 6, 1964. 45p.

A fast coincidence nuclear radiation spectrometer is described. The general features of the design and performance are discussed together with a detailed description of the automation system. (auth)

23893 (AEC-tr-6316(p.24-30)) CALORIMETRIC DETERMINATION OF BETA FLUX. Yota Nakai, Harumi Izura, Koji Matsuda, Yoshihiro Okuda, and Kiichi Kimura. (Translation)

A calorimeter using an aluminum block was devised to monitor the beta flux of a Van de Graaff accelerator. The principles of the operation of the calorimeter are described. It was found to be capable of relative dose measurements with 2% accuracy. The possibility of absolute measurements is considered. (D.L.C.)

23894 (AEC-tr-6316(p.46-58)) BETA DOSIMETRY BY DISCOLORATION OF POLYVINYL CHLORIDE FILM. Yota Nakai, Tsuichi Hiraoka, Harumi Izura, Koji Matsuda, and Kiichi Kimura. (Translation)

The possibility of using coloration of PVC film in beta dosimetry was investigated. Films were made from various PVC powders and heat treated to stabilize the color, and the wavelength for spectrophotometric determination of the color was selected to be 370 mμ. The effects of dose rate, film thickness, and dose on the absorbance were studied. It is concluded that the absorbance change is not affected by the film factors other than thickness in heat treated films and can be used for beta dosimetry with an accuracy of ±10%. (D.L.C.)

23895 STUDY, REALIZATION, AND TUNING-UP OF A MULTICHANNEL DETECTOR (SCALE COUNTER) TO ANALYZE HIGH-ENERGY ELECTRONS (50 TO 250 Mev). Charles Zajde (Ecole Normale Superieure, Orsay, France). Ann. Phys. (Paris) (13), 8: 767-802(Nov.-Dec. 1963). (In French)

A scaler with 11 channels was constructed as a prototype for a 50-channel detector. The detector physics—scintillation and Čerenkov detection, dispersion among the channels, and various perturbations—is described. Counter electronics is discussed, and circuit diagrams are given. Experimental procedures and testing with known radioisotope peaks are covered. (M.J.T.)

23896 LIQUID FLOWING NEUTRON MONITOR. Shigeru Okabe, Kyue Fakuda, Shigeki Nakamura, Toskio Azuma, and Tatuo Kurosu. Ann. Rept. Radiation Center Osaka Prefect., 4: 58-61(1963).

Descriptions are given for a thermal neutron source of the electron linac and a method of continuous monitoring of neutron flux. By using uranium target and water moderator, the ratio of maximum thermal neutron flux/cm^2/sec to total neutron production/sec was measured as 6 × 10^{-4}. A new method of liquid flowing neutron monitor was developed, which circulated liquid solution and detected short-lived radioisotopes formed by a (n,γ) reaction. $Rh_2(SO_4)_3$, $In(NO_3)_3$, and $AgNO_3$ were used as activation elements. (P.C.H.)

23897 RESPONSE OF IONIZATION CHAMBER IN PULSED BEAM. Junichiro Furuta, Eiichi Hiraoka, and Shinichi Okamoto. Ann. Rept. Radiation Center Osaka Prefect., 4: 73-6(1963).

Dosimetry measurements showed that the Victoreen chamber can be used reliably with the maximum pulse length, 1 to 2 μsec and the maximum dose rate of pulse, 1 × 10^7 R/min. In higher or longer pulses, the error may increase. In this case the Compton dosimeter can be used effectively. Comparison between the Victoreen chamber and the Compton dosimeter is illustrated. (P.C.H.)

23898 ABBREVIATION OF DEAD TIME OF QUENCHING CIRCUIT FOR GEIGER-MÜLLER COUNTER. Zdeněk Kučerovský (Inst. of Macromolecular Chemistry, Brno). Cesk. Casopis Fys., 13: 124-8(1963). (In Czech.)

The question of the dead-time of quenching circuits for Geiger-Müller counters is solved and a circuit proposed where the dead time is 12 μsec at a quenching impulse length of 10 μsec. The dead-time of this circuit is about ten times smaller than that of the classical circuits. The simplicity of the quenching circuits used up to now is preserved. (auth)

23899 A QUANTOMETER HAVING CONSTANT SENSITIVITY FOR GAMMA RADIATION ENERGIES ABOVE 15 Mev. A. P. Komar, S. P. Kruglov, I. V. Lopatin, and K. F. Mus (Ioffe Inst. of Physics and Tech., Leningrad). Dokl. Akad. Nauk SSSR, 154: 1318-20(Feb. 21, 1964). (In Russian)

A quantometer is used to measure the energy in a beam of γ quanta. It consists of a multiple-layer ionization chamber. With complete absorption of the γ beam in the material, the ionization of the gas between the plates is plotted as a function of depth, and the area under the curve is proportional to the beam energy. With $E_\gamma > 100$ Mev, the sensitivity of the quantometer is constant, and can be calculated from the following formula: $C = (e\delta_g\overline{a}/w\overline{\rho}\delta_z X_0)$. Here, C is the sensitivity; e is the electron charge; w is the work required to form an ion pair in the gas; $\overline{\rho}$ is the ratio of the mass attenuation coefficients for the solid plate and the gas in the gap; δ_z and δ_g are the densities of the solid and of the gas; $\overline{a}$ is the average gap width; and X_0 is the plate thickness. A model of the quantometer was designed with a total of 18 copper plates of two different thicknesses with $X_0 = 0.4$ cm and $X_0' = 0.8$ cm. The gap after the thick plate was twice as wide as that after the thinner plate with $\overline{a} = 0.15$ cm and $\overline{a}' = 0.3$ cm. An additional gap was designed to correct for leakage of γ rays through the sides. The variation in sensitivity was reduced from 7% to 3.5% for E_γ(max) = 15 to 85 Mev with this quantometer. The sensitivity variation was reduced to <1% 8n using hydrogen gas between the copper plates in the place of air. (TTT)

23900 MEASUREMENTS OF FAST NEUTRONS BY A BF_3 COUNTER IN A PARAFFIN SPHERICAL-HOLLOW

MODERATOR. M. Ladu, M. Pelliccioni, E. Rotondi, and R. Siwicki (CNEN, Frascati, Italy). Energia Nucl. (Milan), 11: 182-5(Apr. 1964). (In Italian)

The response to fast neutrons of a BF_3 counter in a paraffin spherical-hollow moderator was studied. The angular response is uniform and the efficiency for Po–Be, Ra–Be, and D–T neutrons is practically constant. The detection system behaves as a point detector, and the data obey the inverse square law. (auth)

23901 RADIATION MONITORING. W. F. Bland (Radiological Protection Service, Sutton, Surrey, Eng.). J. Sci. Instr., 41: 253-4(May 1964).

Monitoring devices and techniques displayed or demonstrated at the Exhibition of Scientific Instruments and Apparatus are briefly described. Counting equipment and techniques, pocket dosimeters, whole-body monitors, film and emulsion reading equipment, sample changers, semiconductor monitors, and area monitors were included. (D.C.W.)

23902 SEMICONDUCTOR DETECTORS OF NUCLEAR RADIATIONS. W. Abson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Sci. Instr., 41: 272-4 (May 1964).

The operational principle of junction diode detectors is summarized, and some junction detectors and detector applications are discussed. Included were charged particle and neutron spectrometers, total energy E and dE/dx counters for particle identification, and alpha and beta detectors for various medical and health physics applications. (D.C.W.)

23903 A DEVICE FOR DISPLAYING THE DISTRIBUTION OF POSITRON EMITTING NUCLIDES IN VIVO. P. C. R. Turner and P. D. Freebrey (Hammersmith Hospital, London). J. Sci. Instr., 41: 276-7(May 1964).

A device is described in which the simultaneous detection of the 511-kev annihilation gamma rays by a coincidence detector and an image detector (scintillation crystal) allows the event in the image detector to be recorded and registered. The image detector crystal is viewed by photomultipliers, the outputs of which are fed into a computing circuit that positions the electron beam of an oscilloscope. (D.C.W.)

23904 KORPUSKULARPHOTOGRAPHIE IV. VORTRÄGE UND DISKUSSIONEN AUF DEM IV. INTERNATIONALEN KOLLOQUIUM ÜBER KORPUSKULARPHOTOGRAPHIE, MÜNCHEN 1962. (Particle Photography. IV. Reports and Discussions of the Fourth International Colloquium on Particle Photography, Munich, 1962). H. Frieser and G. Heimann, eds. Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 1-700(1963).

Eighty-one papers are included; separate abstracts have been prepared for eighty. Twenty-nine are in French and 15 in German. One paper was previously abstracted in NSA (17: 11333). (T.F.H.)

For abstracts of individual papers see: 23489, 23490, 23491, 23492, 23493, 23494, 23495, 23496, 23497, 23498, 23499, 23550, 23551, 23552, 23553, 23554, 23555, 23556, 23845, 23905, 23906, 23907, 23908, 23909, 23910, 23911, 23912, 23913, 23914, 23915, 23916, 23917, 23918, 23919, 23920, 23921, 23922, 23923, 23924, 23925, 23926, 23927, 23928, 23929, 23930, 23931, 23932, 23933, 23934, 23935, 23936, 23937, 23938, 23939, 23940, 23941, 23942, 23943, 23944, 23945, 23946, 23947, 23948, 23949, 23950, 23951, 23952, 23953, 23954, 23955, 23956, 23957, 23958, 23959, 23960, 23961, 24578, 24642, and 24643.

23905 PARTICLE PHOTOGRAPHY IN THE REALM OF HIGH ENERGIES. P. Cueer (Department de Physique Corpusculaire, Strasbourg). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 11-21(1963). (In French)

An outline is given of the film exposure; conservation and eventual modification of the latent image; developing and fixing the latent image; observation of traces, stripping of pellicles and measuring of events; and various other aspects of the properties of nuclear emulsions. (T.F.H.)

23906 THE PHOTOGRAPHIC EMULSION IN RELATION TO OTHER PARTICLE DETECTORS. E. Schopper (Universität, Frankfurt am Main). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 22-37 (1963). (In German)

Uses and performances of photographic emulsions for particle detection are compared with bubble chambers, scintillation counters, spark chambers, Cherenkov counters, and semiconductor detectors. (M.C.G.)

23907 ORIGIN AND BEHAVIOR OF LATENT IMAGES IN THE CASE OF ELECTRON IRRADIATION. G. Haase (Universität, Frankfurt am Main). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 40-51 (1963). (In German)

An AgBr emulsion was prepared for studies of latent images from electron irradiation. The validity of the reciprocality law of electron irradiation was studied for electrons in the energy range between 20 and 100 kev. The dispersion and topography of latent images were investigated. The effects of electron irradiation at low temperatures were determined. (M.C.G.)

23908 INTERACTION BETWEEN CHARGED PARTICLES AND BOUND ELECTRONS OF SILVER BROMIDE IN PHOTOGRAPHIC EMULSIONS. C. Bogomolov (NIKFI, Moscow). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 52-65(1963). (In French)

The average interaction energies of relativistic charged particles with bound electrons in AgBr in nuclear emulsion are calculated, as is the number of these interactions. The contributions of various sublevels to the interactions are calculated. Weak and peripheral interaction contributions are also calculated. The effective ionization frequency (about 70 events per 100μ) and the development-center formation energy threshold (80 ev) is measured. NIKFI-R emulsion is used. (T.F.H.)

23909 ON THE GRANULATION CURVES DETERMINED FROM THE SENSITIVITY OF IONOGRAPHIC EMULSION. S. Desprez and M. Morand (Faculté des Sciences, Paris). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 66-73(1963). (In French)

Assuming that only delta rays contribute to the formation of the latent image in AgBr crystals in ionographic emulsions, it is possible to determine the variation of the granulation or of the density of blobs as a function of the energy of the ionizing particle. The results agree with experiment, and with calculations based on mean gap lengths. In the case of Ilford GO emulsion, the sensitivity of 3.2 kev permits the observation of the granulation and its variations. (T.F.H.)

23910 QUANTITATIVE ENERGETIC COMPARISON BETWEEN TRACES PRODUCED BY LIGHT PHOTONS AND CHARGED PARTICLES. R. Schmitt and R. Rechenmann (Department de Physique Corpusculaire C.R.N., Strasbourg). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 74-84(1963). (In French)

The curve of sensitivity of nuclear emulsions for charged particles is determined from the grain density along the trajectory as a function of the particle energy. In order to use the same criteria for exposures of the emulsions to light photons, the imaginary-path method is used. Since the proper imaginary path is quite difficult to find for technical reasons, macroscopic regions are studied in which the imaginary path is represented by an arbitrary straight line. (T.F.H.)

23911 UTILIZATION OF LOW TEMPERATURE FOR BETTER DISCRIMINATION BETWEEN HIGH-ENERGY PARTICLES. M. Debeauvais-Wack (Departement de Physique Corpusculaire, Strasbourg). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 85-96 (1963). (In French)

The regression of latent images produced by 22-Bev protons in Ilford G-5 and K-5 emulsions is studied as a function of the temperature at which the emulsion is stored. For storage temperatures of 0 to −40°C, the image regression is found to vary only a small amount and is found to be much smaller than that observed at 20°C. (T.F.H.)

23912 GAMMA-PARTICLE DISCRIMINATION IN ILFORD EMULSIONS BY DISCRIMINATORY DEVELOPMENT. F. Libourel and R. Schmitt (Centre de Recherches Nucleaires, Strasbourg). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 97-100(1963). (In French)

Measurements are reported of the discrimination of gamma rays and particles in Ilford K emulsion. Particular attention is given to gamma−alpha discrimination studies using Ra as the gamma source and ^{210}Po as the alpha source. (T.F.H.)

23913 ON THE STRUCTURE AND SIZE OF CENTERS OF SENSITIVITY AND CENTERS OF DEVELOPMENT IN HIGH-SENSITIVITY R EMULSION. D. M. Samoylovich, V. I. Kalachnikova, and E. S. Barinova (Inst. of Atomic Energy, Moscow). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 101-8(1963). (In French)

The effects of dilute acidic treatment of 400-μ-thick layers of R emulsions at various temperatures are examined. As an indicator of the effect of the acid, the grain density in relativistic particle tracks is chosen. The results are used to analyze the structure and size of centers of sensitivity and centers of development in the emulsion. (T.F.H.)

23914 ON THE PHOTOMETRIC EQUIVALENT OF PHOTOGRAPHIC BLACKENING PRODUCED BY THE ACTION OF LIGHT AND NUCLEAR RADIATIONS. A. L. Kartuzhanskii, K. V. Vendrovskii, and O. V. Pyasetskaya (Inst. for Soviet Commerce, Leningrad). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 109-14 (1963).

Experiments are carried out to investigate the optical properties of developed grains, which form the blackening of nuclear emulsion film. The object of the investigation is an insight into the dependence of these optical properties on the nature of the radiation, duration, and other conditions of exposure. An attempt is made to determine whether variations of the density of blackening upon exposure can be ascribed to the variation of the covering power of developed Ag. (T.F.H.)

23915 RESOLVING POWER OF PHOTOGRAPHIC LAYERS EXPOSED TO NUCLEAR RADIATIONS. A. L. Kartuzhanskii and B. P. Soltitskii (Inst. for Soviet Commerce, Leningrad). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 115-25(1963).

Methods similar to those used in optical photographic resolvometry are applied to the determination of the resolving power of photographic films for sheets of alternately radioactive and inactive materials. The sheets have several thicknesses, and various radioisotopes are used in the radioactive sheets. Alpha-, beta-, and gamma-emitters are used. After the sheets are sandwiched, the photographic film is placed against the sandwich, perpendicular to the plane of the sandwich. (T.F.H.)

23916 THE ACTION OF ION BEAMS ON NUCLEAR EMULSIONS. H. Ewald, E. Burlefinger, M. Vogler, and B. Kaiser (Technische Hochschule, Munich). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 126-30(1963). (In German)

Yields of darkened grains in nuclear emulsion bombardment with ions of different masses and energies were determined with the help of a double-focusing mass spectrograph. Sensitivities were determined and plotted for H^+, Ne^+, H_2^+, D_2^+, He^+, D^+, Ar^+, Kr^+, and Xe^+. (M.C.G.)

23917 PHOTOGRAPHIC EMULSIONS FOR NUCLEAR RESEARCH, TYPE M NIKFI. A. A. Sirotinskaya, K. S. Bogomolov, and M. Y. Deberdeev (NIKFI, Moscow). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 231-3(1963). (In German)

The M-type nuclear emulsion is fine-grained and registers tracks of relativistic particles with a density of 30 grains per micron. Size distribution of microcrystals in this type of emulsion and its photographic properties were determined. (M.C.G.)

23918 THE CHANGE OF PROPERTIES OF ULTRA-FINE NUCLEAR EMULSIONS BY AGING. B. Zizic and J. Vukovic (Inst. of Physics, Belgrade). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 234-41 (1963).

During the aging of photonuclear emulsions different physicochemical processes take place which very often lead to fundamental changes in the properties of the emulsions. The original properties change in time and the photonuclear emulsions become inapplicable. Therefore, it is important to know the behavior of each new photographic material during its aging period. The aging process in nuclear emulsions should be pronounced because of the large concentration of AgBr in the emulsion, and because of the small grain size. The purpose of this work was to study the properties of an ultra-fine nuclear emulsion during its chemical ripening, its sensitization by gold-chloric acid ($AuCl_3HCl$) and TEA, and its 12-month aging period. (T.F.H.)

23919 LOADING OF EMULSION STACKS WITH AQUEOUS SOLUTIONS OF LITHIUM ACETATE. D. H. Davis, R. Levi Setti, M. Raymund, and G. Tomasini (Univ. of Chicago). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 273-8(1963).

Stacks of 1200 μm Ilford K-5 unmounted pellicles have been successfully loaded with concentrated aqueous solutions of lithium acetate. The soaked pellicles, which swell to 2 to 2.5 mm thickness, are assembled to form a stack, which is frozen and kept at dry ice temperature until processing. Some results are presented concerning the composition and quality of the emulsions. Relevant quantities are compared for normal, water-loaded, and lithium-loaded emulsion, as derived from chemical analysis. The penetration of lithium throughout the emulsion, for test pellicles exposed to slow neutrons, is determined by counting $^6Li(n,\alpha)^3He$ reactions at various depths in the emulsion.

The uniformity and level of track ionization is unimpaired by the loading procedure. The blob density of 1.4 Bev/c K^- tracks is shown as a function of depth in the emulsion. There appears to be no significant gradient, while the minimum-ionization blob density is particularly high (30.3 blobs/100 μm). Scattering measurements have also been made on the same beam tracks, yielding $p\beta$ values consistent with the nominal beam momentum. The lateral shrinkage of the free pellicles is measured and found effectively uniform. (T.F.H.)

23920 INVESTIGATIONS ON THE CHARACTERISTICS OF NUCLEAR EMULSIONS LOADED WITH TUNGSTEN. V. S. Bychenkov and N. A. Perfilov (Inst. of Radium, Leningrad). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 279-82(1963).

The characteristics are given of tungsten-loaded photographic layers, along with some preliminary experimental data on tungsten fission by protons of 660 Mev energy. (T.F.H.)

23921 DETECTION OF LOW-INTENSITY RADIATIONS WITH NUCLEAR TRACK EMULSIONS TREATED FOR LATENT IMAGE ERADICATION. J. J. Lord, C. G. Bachhuber, D. M. Cottrell, and E. R. Goza (Univ. of Washington, Seattle). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 286-91(1963).

Originally the instability of the latent image in the nuclear emulsion was a major source of difficulty with its use as a detector of particle tracks. However, the present day emulsion is quite stable and fading is no longer a problem except in the case of unusual experiments. On the other hand, there are some experiments wherein it is desirable to deliberately produce fading in the emulsion and then restore it to its original sensitivity and stability. Experiments with very weak radioactive sources and low-intensity underground cosmic ray measurements require an emulsion that is largely free of extraneous background before the measurements are begun. This can be accomplished by the use of emulsions immediately after pouring or by resorting to a procedure to remove the latent images from older emulsions. The former method is not too practical if it is desirable to make up large stacks of pellicles for underground cosmic ray measurements. Work is reported, concerned with a discussion of techniques that have proved practical in producing a large stack of emulsions that are free of background tracks at the start of low-intensity underground cosmic ray experiments. (T.F.H.)

23922 MOISTURE INFLUENCE ON THE STABILITY OF THE PHOTOGRAPHIC CHARACTERISTICS OF NUCLEAR EMULSIONS, WHICH REGISTER RELATIVISTIC PARTICLES. K. M. Romanovskaya and K. S. Bogomolov (NIKFI, Moscow). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 292-302(1963). (In German)

The effects of moisture in the surrounding atmosphere on changes of the photographic properties of emulsion Type R NIKFI and on the fading of the latent images were investigated. The change of grain density for a relativistic particle served as stability criteria for the photographic properties. Moisture was found to make the emulsion less sensitive. The reversibility of this effect was studied. The influence of moisture on the photographic sensitivity was found to be reversible, while the influence on the latent image (fading) was irreversible. (M.C.G.)

23923 ON THE POSSIBILITY OF NUCLEAR EMULSION HAVING CHANGING SENSITIVITY DURING IRRADIATION. D. M. Samoylovich, E. S. Barinova, and I. V. Ardachev (Inst. of Atomic Energy, Moscow). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 303-8(1963). (In French)

It is found that the introduction of H^+ ions into photographic emulsion layers causes the pH of the layers to change during the irradiation of these layers. The variation in pH produces a corresponding change in the sensitivity of the emulsion to particles. (T.F.H.)

23924 STRUCTURE CHANGES IN α-PARTICLE AND ELECTRON TRACKS IN THE PROCESS OF DEVELOPING THE NUCLEAR EMULSIONS. N. P. Kocherov and N. A. Perfilov (Inst. of Radium, Leningrad). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 310-16 (1963).

When registering charged particles by means of photographic emulsions, one meets with the problem of discriminating the nature of particles by the character of their tracks in the emulsion. Many peculiarities in the tracks of low-ionization particles have found a theoretical explanation on base of stochastic examination. The development kinetics of tracks of α particles and electrons with comparatively low energy are studied where primary ionization is predominant (the number of δ electrons, with energy sufficient for escaping from the grain, is small). (T.F.H.)

23925 VERY THIN PLATES HAVING CENTRAL SUPPORTS. Claude Bovet (Université, Neuchâtel, Switzerland). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 317-20(1963). (In French)

Nuclear emulsion plates having thicknesses of 1200 μ are fabricated by sandwiching a 6-μ-thick Mylar sheet between two 600-μ-thick unsupported emulsion sheets. The Mylar sheet provides support for the emulsion sheets. The dimensional stability and performance of the supported and unsupported emulsions are compared. (T.F.H.)

23926 STUDIES OF VARIOUS METHODS FOR TREATING UNSUPPORTED LAYERS OF TYPE BR EMULSION, PREVIOUSLY GLUED ON GLASS. T. I. Krestovnikova and V. M. Ouvarova (NIKFI, Moscow). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 321-8 (1963). (In French)

A study of methods for processing layers of BR emulsion shows that a "wet" method gives the best uniformity and depth of development of charged particle tracks. The properties of layers developed by this method are otherwise similar to those of layers developed by the "dry" method. (T.F.H.)

23927 THE DEVELOPMENT OF R NUCLEAR EMULSION IN AN ELECTRODIALYZER. D. M. Samoylovich and V. G. Tarassenkov (Inst. of Atomic Energy, Moscow). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 329-32(1963). (In French)

A method for developing nuclear emulsions by electrodialysis is described. It is found that the method is not suitable for developing large numbers of plates or for obtaining rapid qualitative results, but is otherwise feasible. (T.F.H.)

23928 ETCHING EFFECTS DURING PROCESSING. Glenn M. Frye and Yale D. Harker (Case Inst. of Tech., Cleveland). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 336-8(1963).

It is found that "etching" or "corrosion" of photographic images in nuclear emulsion may occur under certain conditions in the stop bath. This etching increases with depth in the emulsion, and can be severe enough to completely obliterate some particle tracks except at the emulsion surface. (T.F.H.)

23929 DISCRIMINATION OF LOW-ENERGY PROTONS IN HEAVY GAMMA RAY BACKGROUND. H. G. de Carvalho, M. Muchnik, G. Potenza, and R. Rinzivillo (Università, Naples and Istituto Nazionale di Fisica Nucleare, Naples). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 346-50(1963).

An experimental survey is carried out on the discrimination of protons up to 14.5 Mev from background gamma rays. Information on the maximum permissible gamma dose for a given proton energy and the maximum visible energy for a given gamma dose is collected. The study is carried out by varying the parameters of emulsion sensitivity, emulsion grain size, development type, and development time. (T.F.H.)

23930 DETECTION OF ALPHA PARTICLES IN THE PRESENCE OF HEAVY GAMMA-RAY BACKGROUND BY ILFORD NUCLEAR EMULSIONS. M. Elaine Toms (Naval Research Lab., Washington, D. C.). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 351-5 (1963).

Ilford C-2, E-1, K-0, K-1, and K-2 nuclear emulsions are exposed to 22-Mev bremsstrahlung, and photonuclear reactions in the emulsions yielding alpha particles are detected in the emulsions. The alpha particle tracks can be discriminated in the gamma background for gamma doses up to 1200 r, under certain development conditions. (T.F.H.)

23931 ON INCREASING THE DISCRIMINATION CAPACITY OF NUCLEAR EMULSION BY USING SUPERPROPORTIONAL INTENSIFYING. A. P. Zhdanov, L. I. Shur, and G. G. Martysh (Inst. of Radium, Leningrad). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 356-62(1963).

The tracks of alpha particles and protons in nuclear emulsions are discriminated by superproportional intensification of the tracks. The increase of blackening density under the action of the intensifier varies as the absolute value of the initial track density. The intensifier used is a double-bath Hg intensifier. (T.F.H.)

23932 ALPHA–PROTON DISCRIMINATION AT LOW ENERGIES IN ILFORD C2 AND K2 EMULSIONS. A. Garin (CEN, Saclay, France). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 363-6(1963). (In French)

A developing solution is presented for C-2 and K-2 emulsions that allows alpha particles and protons to be discriminated in a gamma background. Results obtained with this solution are shown. (T.F.H.)

23933 DISCRIMINATION OF PROTONS AND ALPHA PARTICLES BY MEANS OF ILFORD K0 NUCLEAR EMULSIONS. M. Paić and V. Paić (Inst. "Ruder Boskovic," Zagreb). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 367-79(1963).

In order to use a nuclear emulsion for the spectrometry of alpha particles emitted from a nuclear reaction, in which protons also appear, it is necessary to satisfy the following conditions: a good discrimination of the tracks of alpha particles from the tracks of protons should be possible; the relation between the measured track lengths and the energy of alpha particles should be sufficiently precise to obtain the energy spectrum; and the background caused by development should be small, so as not to prohibit the observation and measurement of alpha particle tracks. Ilford K0, K minus 1 and K minus 2 emulsions are studied, to see to what extent they satisfy the above conditions. It was shown that only K0 emulsions are satisfactory, since only this kind of emulsions, in the conditions of development used, detects the tracks of alpha particles. (T.F.H.)

23934 NOTES ON SPURIOUS SCATTERING INVESTIGATIONS. E. Dahl-Jensen (Universitet, Copenhagen). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 380-6(1963).

A series of spurious scattering investigations is carried out in Ilford emulsions exposed to protons of 7 and 24 Bev. The behavior of the spurious scattering signal with spurious parameters has been examined. The presence of spurious scattering is sought in terms of an effect of nonuniform distortion. (T.F.H.)

23935 INFLUENCE OF SOME DEVELOPMENT FACTORS ON THE PARASITIC SCATTERING. R. Delessert and P. Heinzer (Laboratoire de Recherches Nucléaires, Lausanne, Switzerland). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 387-94(1963). (In French)

Certain irreversible deformations undergone by nuclear emulsions during development cause errors in measurements of multiple scattering. Experimental results are presented that show that the parasitic scattering is essentially a function of the temperature of the hot process, the concentration of Ag in the fixing bath, and the drying conditions. The relative magnitudes of these effects are studied for 24-Bev proton tracks in Ilford K-5 emulsion. (T.F.H.)

23936 ON THE POSSIBILITY OF REDUCING THE PARASITIC SCATTERING IN NUCLEAR EMULSIONS. M. Nicolae and M. Pirvu (Inst. of Atomic Physics, Bucharest). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 395-8(1963). (In French)

The effects of several development methods on the spurious scattering in thick nuclear emulsions are studied. The development methods used, viz. isothermal, using a hot dry phase, using a hot wet phase, etc., are compared, and the comparisons are used to draw conclusions as to the general behavior of the emulsion during various types of development processes. (T.F.H.)

23937 HIGH GRAIN DENSITIES IN NUCLEAR EMULSIONS. A. E. Sichirollo and P. P. Sverzellati (Istituto Nazionale di Fisica Nucleare, Milan). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 402-9 (1963).

Developing techniques are found for use when the primary goal is a rapid accumulation of large statistical aggregates, rather than accurate mass measurements. In keeping with this goal, the development method permits an increase in the grain density for a given ionization, while maintaining a low level in the background of spontaneously developed grains. (T.F.H.)

23938 TECHNICAL ASPECTS OF THE USE OF MAGNETIC FIELDS IN NUCLEAR EMULSIONS: THE USE OF GUARD RINGS IN PROCESSING. G. Vegni (Università, Milan and Istituto Nazionale di Fisica Nucleare, Milan). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 410-14(1963).

The distortion of tracks in nuclear emulsion that is surrounded by a guard ring of similar or unlike nuclear emulsion is found experimentally to be lower than that of emulsions having no guard ring. The guard rings are in place during the complete processing cycle of the emulsions. (T.F.H.)

23939 VIDEO TRACK ANALYSIS. Walter H. Barkas, Harry H. Heckman, James C. Hodges, and Jack G. Salvador (Univ. of California, Berkeley). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 416-25(1963).

Three parameters contain the practical information content of a particle track with respect to its grain density. These are the mean gap length, the mean blob length, and the mean track width. A goal of automatic track analysis is the measurement of these quantities rapidly and objectively. An instrument has been constructed to do this by means of a microscope and closed-circuit television system. The design includes mechanical, optical, and electronic features, which are described. (T.F.H.)

23940 TRACK RECONSTRUCTION AND MULTIPLE SCATTERING MEASUREMENTS WITH A DIGITIZED KORISTKA MICROSCOPE. John N. Dyer, Walter H. Barkas, Harry H. Heckman, Maung Hla Shwe, and Frances M. Smith (Univ. of California, Berkeley). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 426-32 (1963).

The use of a digitized-travel microscope for accurate determination of the positions of grains making up the tracks of particles in nuclear emulsion is described. The position readings obtained with the microscope are punched onto IBM cards for computer analysis. The origin of stars with minimum ionizing tracks can be located within a "circle of confusion" of radius about 0.04μ. (T.F.H.)

23941 SOME RESULTS AT STRASBOURG IN THE DOMAIN OF STRIPPING, SEMI-AUTOMATION OF GAP MEASUREMENTS, SCATTERING, AND TRACK SURFACE MEASUREMENTS FOR HIGH-ENERGY STUDIES. P. Poubeau and H. Braun (Centre de Recherches Nucléaires, Strasbourg). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 433-46(1963). (In French)

Methods and equipment are described for partly automatic microscopic analysis of tracks in nuclear emulsion plates; for the temperature method of developing nuclear emulsion; and for the use of television techniques for track analysis. The microscopic method for track scanning uses ferrite memories. (T.F.H.)

23942 AUTOMATIC SCATTERING AND IONIZATION MEASUREMENTS ON FAST PARTICLE TRACKS IN PHOTOEMULSIONS. A. E. Voronkov, G. B. Zhdanov, and L. V. Suchov (Lebedev Inst. of Physics, Moscow). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 447-63(1963).

A device is described that can automatically: scan particle tracks in nuclear emulsion; determine the track coordinates of the individual blobs in the track; calculate the first, second, and third coordinate differences for the blobs; measure the blob- and gap-length distributions; and center the track to be studied in the working zone of the scanner. The device utilizes television displays. (T.F.H.)

23943 PHOTOMETRIC DISCRIMINATION BETWEEN LOW-ENERGY PROTONS AND DEUTERONS IN ILFORD K5 EMULSIONS. M. Della Corte (Università, Florence). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 464-7(1963). (In French)

Proton and deuteron tracks are discriminated in nuclear emulsion by a determination of their respective photometric widths. The protons and deuterons have energies below 2 to 3 Mev. (T.F.H.)

23944 CONTROL OF SCANNING EFFICIENCY AND ESTIMATION OF THE TRUE NUMBER OF EVENTS. S. N. Sokolov and K. D. Tolstov (Joint Inst. for Nuclear Research, Dubna, USSR). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 468-79(1963).

Statistical methods are introduced for determining and controlling the efficiency of scans through given volumes of nuclear emulsions and for estimating the true number of events in the volume scanned. (T.F.H.)

23945 DETERMINATION OF THE MOMENTUM OF HIGH-ENERGY PARTICLES IN IONOGRAPHIC EMULSIONS: COMPARISON OF SEVERAL MULTIPLE-SCATTERING METHODS. J. Bermond, R. Brou, and C. Patou (Université, Caen, France). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 480-4(1963). (In French)

The results of three expressions for calculating the momentum of relativistic particles are compared for the case of 8.16-Bev/c muons. The methods used are: two cell lengths; three cell lengths; and constant-ratio. (T.F.H.)

23946 ON METHODICAL RESULTS OBTAINED WITH EMULSIONS PLACED IN THE 48 KG MAGNETIC FIELD. E. A. Lopatina, L. G. Popova, B. A. Shahbazian, and K. D. Tolstov (Joint Inst. for Nuclear Research, Dubna, USSR). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 485-95(1963).

Nuclear emulsions are placed in a 48 kOe transverse magnetic field, which is cylindrical with a diameter of 80 mm and a height of 26 mm. Tracks of incident negative pions at 3.86 Bev/c, and of the products of π^-–N interactions, are followed. Several methods are used to calculate the charges and momenta of the particles forming these tracks, and the results of the methods are compared. (T.F.H.)

23947 ON THE DETECTION OF SMALL ANGLES OF SCATTERING. V. Pelosi (Università, Milan). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 496-8(1963).

In order to detect elastic single scattering events for 16-Bev/c negative pions in nuclear emulsion, a multiple-scattering-type search is made along 38.5 m of track, using a 2-mm-long basic cell. Events in which the pion is deflected by as little as 2.5 mrad are detected, and the cross section for elastic scattering through angles greater than or equal to 3 mrad is calculated as 70 mb. A total of 21 events is detected in the 38.5 m scanned. (T.F.H.)

23948 USE OF NUCLEAR PHOTOGRAPHIC EMULSIONS FOR THE INVESTIGATION OF THE ELASTIC SCATTERING OF HIGH ENERGY PROTONS ON He_2^4 AND NUCLEAR REACTIONS ON LIGHT ELEMENTS. A. P. Zhdanov, V. N. Kuzmin, and R. M. Yakovlev (Inst. of Radium, Leningrad). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 499-503(1963).

The elastic scattering of protons by ^4He and the reaction $^9Be(p,\alpha)$ are studied by detecting the recoil nucleus (^4He and α respectively) at angles near 90° in nuclear emulsion. The method can be used to study cross sections, polarization effects, etc. (T.F.H.)

23949 NOTE ON A WORKING PRECISION OBTAINABLE IN THE MEASUREMENT OF SMALL ANGLES. A. E. Sichirollo and G. Vegni (Università, Milan and Istituto Nazionale di Fisica Nucleare, Milan). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 504-12 (1963).

An experiment is carried out to determine the accuracy obtainable in the analysis of 16-Bev negative-pion tracks in nuclear emulsion, consistent with the time limits imposed by the desirability of scanning as long a track length as possible in a given time. It is found that a "working" precision of about 0.1° can be obtained in the measurement of small scattering angles. (T.F.H.)

23950 DISTORTION IN NUCLEAR EMULSIONS AND ITS INFLUENCE ON MULTIPLE COULOMB SCATTERING MEASUREMENTS. P. K. Aditya (Coll. of Engineering and Tech., New Delhi, India). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 513-32(1963).

Factors producing distortion in nuclear emulsions are outlined, and the relation between distortion and spurious scattering is investigated. Experimental observations on plates exposed to cosmic radiation are discussed. (T.F.H.)

23951 DISTORTION AND SPURIOUS SCATTERING. P. Heinzer and R. Delessert (Laboratoire de Recherches Nucleaires, Lausanne, Switzerland). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 533-41 (1963). (In French)

Correlations are sought and examined between distortion and spurious scattering events in nuclear emulsions. (T.F.H.)

23952 COMPARISON BETWEEN VARIOUS EMULSIONS IN THE REGION OF THE RELATIVISTIC RISE IN IONIZATION LOSS. B. Stiller (Naval Research Lab., Washington, D. C.). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 542-57(1963).

The ionization loss of energy by relativistic charged particles in nuclear emulsions has been studied. The availability of electron-sensitive emulsions with a variety of mean grain diameters (G.5$-$0.27μ, K.5$-$0.2μ, and L.4$-$0.14μ), led us to perform an experiment designed to investigate the possible effect of emulsion grain diameter on the relativistic rise in ionization loss in the region from its minimum value to the Fermi "plateau," as measured by the blob density of "relativistic" tracks. (T.F.H.)

23953 IONIZATION-MOMENTUM DEPENDENCE FOR ELECTRONS IN THE ULTRARELATIVISTIC REGION. K. L. Alekseeva, G. B. Zhdanov, M. I. Tretyakova, V. N. Zytovitch, and M. N. Shcherbakova (Lebedev Inst. of Physics, Moscow). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 558-64(1963).

The relations between blob density distributions, momentum, and emulsion properties are examined for the tracks of electrons at 0.1 to 5 Bev/c and protons at 19.6 Bev/c in various nuclear emulsions. (T.F.H.)

23954 DISCRIMINATION OF HEAVY IONS IN THE NUCLEAR EMULSION. P. A. Gorichev, O. V. Lozhkin, and N. A. Perfilov (Inst. of Radium, Leningrad). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 565-78(1963).

Experimental and theoretical data on discrimination of multicharged ions in nuclear emulsions allows certain optimum conditions of getting best ion discrimination to be found in the region of $Z > 2$. Such optimum conditions are maximum sensitivity and minimum size of emulsion microcrystals at conventional development procedures. (T.F.H.)

23955 APPLICATION OF NUCLEAR EMULSIONS TO SPACE RESEARCH, INCLUDING ENVIRONMENTAL TESTING, RECOVERY ASPECTS, AND TIME RESOLUTION. C. E. Fichtel and J. E. Naugle (Goddard Space Flight Center, Greenbelt, Md.). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 611-17(1963).

The advantages of nuclear emulsion detectors for space-probe uses in which payload recovery is possible are outlined. It is noted that systems for carrying and recovering emulsion payloads are in existence. Attention is directed to small sounding rocket payloads that allow a fair amount of flexibility in the experimental arrangement. Methods are discussed for obtaining time resolution and measuring extremely large fluxes. (T.F.H.)

23956 DEVELOPMENT PROBLEMS ASSOCIATED WITH THE EXPOSURE OF NUCLEAR EMULSIONS IN SPACE PROBES. Herman Yagoda (Air Force Cambridge Research Labs., Bedford, Mass.). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 618-34 (1963).

The processing and exposure of nuclear emulsions in space probes is discussed. Techniques for overcoming problems associated with the development of these emulsions are presented. These problems include the wide variation in the absorbed radiation doses, the choice of thickness in cutting the emulsion, extraordinary measures required by exposure of the film to solar-flare particles or prolonged exposure to high total doses, etc. (T.F.H.)

23957 CONTROLLED EXPOSURE OF NUCLEAR EMULSIONS ON SPUTNIKS. Ya. M. Veprik, L. V. Kurnosova, L. A. Razorenov, K. D. Tolstov, M. I. Fradkin, and V. S. Chukin (Joint Inst. for Nuclear Research, Moscow). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 635-41(1963).

An apparatus is described that carries out a partial development of exposed nuclear emulsions on board a satellite. Following this partial development, the emulsions are insensitive to further irradiation. The final processing of the film can be carried out after recovery of the satellite. The apparatus described thus permits the duration of exposure of the emulsion to be controlled. (T.F.H.)

23958 NUCLEAR EMULSION TECHNIQUES FOR FISSION STUDIES. H. G. De Carvalho and A. G. Da Silva (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 654-64(1963).

The preparation, processing, development, reading, and interpretation of nuclear emulsion plates for nuclear fission studies is reviewed. Particular attention is directed to the development aspects. (T.F.H.)

23959 IONOGRAPHIC STUDY OF INDIVIDUAL FRAGMENTS FROM THE FISSION OF THORIUM-232 BY 15.3-Mev NEUTRONS. C. Cardinal and G. Carreau (Univ. of Montreal). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 665-7(1963). (In French)

Analytic methods and partial results are discussed, for the analysis of fast-neutron fission of ^{232}Th using nuclear emulsion. (T.F.H.)

23960 RESPONSE OF IONOGRAPHIC EMULSIONS IN THE SPECTRAL ANALYSIS OF FAST NEUTRONS. C. Beets (Centre d'Etude de l'Energie Nucléaire, Mol, Belg.), P. Colle, H. Deckers, A. Desprets, and G. Gierts. Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 675-83(1963). (In French)

The use of nuclear emulsions for fast-neutron spectroscopy (e.g., in reactors or critical assemblies) is examined. The response of emulsions is investigated and compared with that of semiconductor junction detectors. (T.F.H.)

23961 SOURCES OF ERROR IN NEUTRON PERSONAL DOSE MEASUREMENTS BY MEANS OF NUCLEAR TRACK EMULSIONS. K. Becker (Kernforschungsanlage, Julich, Ger.). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 684-93(1963). (In German)

Uses of nuclear emulsions in radiation protection monitoring of personnel for fast neutron doses are discussed. Sources of error were studied, the amount of error determined, and methods of reducing this error suggested. Energy dependence and fading were found to be the two most important sources of errors. (M.C.G.)

23962 SILICON SURFACE-BARRIER DETECTOR WITH A GUARD-RING AND ITS POSSIBLE APPLICATIONS. Janina Chwaszczewska (Inst. of Nuclear Research, Warsaw), Miroslaw Dakowski, Mieczyslaw Sowin'ski, Andrzej Dabrowski, and Mieczyslaw Slapa. Nukleonika, 9: 11-18(1964). (In Russian)

The design of a silicon surface barrier detector for nuclear radiation is described. It has a guard ring and a depletion layer of 1 mm thickness and can be used for spectrometry of charged particles. Extensive experiments were conducted to obtain performance characteristics, to determine its resolution, sensitivity, and factors on which the pulse amplitude depends. The circuit is shown and results are plotted graphically. (P.C.H.)

23963 PARAMETERS OF ZnS(Ag) SCINTILLATORS. Waldemar Scharf (Bureau for Applications of Nuclear Technology, Warsaw). Nukleonika, 9: 67-70(1964). (In Polish)

The production of ZnS(Ag) phosphors based on optimum film thickness and maximum relative efficiency is reported. Various models are described, including their construction, performance parameters, and characteristics. (P.C.H.)

23964 EFFECTS OF TEMPERATURE ON PLASTIC SCINTILLATORS AND ITS COMPENSATION. Ramon H. Schulczewski (Universidad Mayor De San Andres, La Paz, Bolivia). Publ. Lab. Fis. Cosmica, Univ. Mayor San Andres, No. 24, 19-25(May 1963). (In Spanish)

In view of the large number of plastic scintillators used in many experiments at the Laboratory of Chacaltaya, it was necessary to have a method of compensating for the temperature effects on this material. A method using thermistors in the photomultiplier circuit is suggested to compensate for this effect. (auth)

23965 DETERMINATION OF ARRIVAL DIRECTIONS OF EXTENSIVE AIR SHOWERS WITH FAST TIMING ARRAY DETECTORS. F. Angel Garcia Ontiveros (Universidad Mayor De San Andres, La Paz, Bolivia). Publ. Lab. Fis. Cosmica, Univ. Mayor San Andres, No. 24, 27-39(May 1963). (In Spanish)

A millimicrosecond timing apparatus to determine arrival directions of extensive air showers used in the BASJE experiment is described. Equipment, electronics, location, and data processing are discussed. Using fast-timing-array detectors, the accuracy is about ±5%. (auth)

23966 TRANSISTORIZATION OF NEUTRON MONITOR. C. J. Bland and R. Nogales (Universidad Mayor De San Andres, La Paz, Bolivia). Publ. Lab. Fis. Cosmica, Univ. Mayor San Andres, No. 24, 45-6(May 1963). (In Spanish)

Owing to frequent power cuts during the winter months, the standard neutron monitor was transistorized. A brief description is given of the circuitry and modifications. Power for the monitor during cuts in power supply is completely derived from automobile batteries. (auth)

23967 THE LITHIUM-DRIFTED SILICON p-i-n JUNCTION AS AN X-RAY AND GAMMA-RAY DOSIMETER. Norman A. Baily and Gordon Krammer (Hughes Research Labs., Malibu, Calif.). Radiation Res., 22: 53-80(May 1964).

The characteristics of the response of lithium-drifted p-i-n junctions in silicon to x and γ rays were examined over the range of energies from 21 kev to 1.25 Mev. The parameters studied were wavelength dependence, dose-rate dependence, influence of intrinsic volume, and temperature dependence. Dose rates were examined in the range of 1 μr/hr to 1500 r/min. Temperatures studied varied from 0 to 50°C. Intrinsic region widths varied from 0.25 to 2.5 mm. (auth)

23968 INVESTIGATION OF THE MECHANISM OF OPERATION OF TRACK SPARK CHAMBERS. G. E. Chikovani, V. N. Roinishvili, and V. A. Mikhailov (Inst. of Physics, Academy of Sciences, Georgian SSR). Zh. Eksperim. i Teor. Fiz., 46: 1228-39(Apr. 1964). (In Russian)

The principle of operation of a new detector of charged particles, the track spark chamber, is based on termination of the streamer discharges induced by primary electrons at an early stage of development. In this case the particle tracks can be discerned by the glowing centers along the particle trajectory. In contrast to the familiar spark chambers, the track spark chamber possesses isotropic properties in the sense that it records in space particles moving in any direction with respect to the electric field. The characteristics of a 100 × 60 × 19 cm^3 operating track chamber were studied. A statistical model of development of the glowing centers is proposed for explaining the operation of the track chamber. The conclusions based on this model are in satisfactory agreement with the experimental results. (auth)

23969 SEMICONDUCTOR COUNTERS FOR NUCLEAR RADIATIONS. G. Dearnaley and D. C. Northrop. London, E. & F. N. Spon Limited, 1964. 347p.

Properties of nuclear radiation, detection methods, physical properties of solid-state counters, the noise and limit of energy resolution in operation of counters, homogeneous conduction counters, rectifying junction counters, the preparation and properties of semiconductor junction counters, instrumentation for semiconductor counters, applications of semiconductor counters, and a survey of radiation damage in semiconductor detectors are discussed. Numerous references are given. (R.E.U.)

23970 NUCLEAR ELECTRONICS. Proceedings of the International Symposium, Paris, November 25-27, 1963. Paris, European Nuclear Energy Agency (ENEA), 1964. 861p. F 40; FS 40; DM 33; £ 3 3; $10.00.

Separate abstracts were prepared for 87 of the 96 papers presented; 9 were previously included in NSA 17: 41591; 18: 5627, 5670, 7077, 7405, 8640, 16275, 18214, and 18216. (R.E.U.)

For abstracts of individual papers see: 23434, 23849, 23850, 23851, 23852, 23853, 23854, 23855, 23856, 23857, 23858, 23859, 23860, 23861, 23862, 23863, 23864, 23971, 23972, 23973, 23974, 23975, 23976, 23977, 23978, 23979, 23980, 23981, 23982, 23983, 23984, 23985, 23986, 23987, 23988, 23989, 23990, 23991, 23992, 23993, 23994, 23995, 23996, 23997, 23998, 23999, 24000, 24001, 24002, 24003, 24004, 24005, 24006, 24007, 24008, 24009, 24010, 24011, 24012, 24013, 24014, 24015, 24016, 24017, 24018, 24019, 24020, 24021, 24022, 24023, 24024, 24025, 24026, 24027, 24028, 24029, 24030, 24031, 24032, 24033, 24034, 24035, 24036, 24063, 24266, 24827, and 24828.

23971 SPARK CHAMBERS: THE STATE OF THE ART. A. Roberts (Argonne National Lab., Ill.). p.21-41 of "Nuclear Electronics." Paris, ENEA, 1964. (CONF-369-4)

The introduction of spark chambers as a tool in high-energy physics in 1958 to 1960 has been followed by an explosive growth in their use. Since the Spark Chamber Symposium in 1961 much technical development has occurred, and nowadays the electronic high-energy particle detector array that does not include spark chambers in some form is rare. The increasing variety of spark chambers allows them to be classified according to several different parameters. Recording of the discharge may be by acoustic, electrical, or optical means; the recording may be analog or digital; it may be on film, magnetic tape, or in core storage; and the chamber operation itself may yield an analog (track-delineating) representation of the particle trajectory, or a partially or completely digitized representation. It is convenient to use the last method of classification for discussion. (auth)

23972 EXCITATION AND IONIZATION PRODUCED BY α PARTICLES IN RARE GASES AND THEIR MIXTURES. J. L. Teyssier, D. Blanc, and A. Godeau (Centre de Physique Nucleaire, Toulouse). p.43-8 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

It is found that electric fields of sufficiently high amplitude and magnitude have an amplifying effect on the luminescence of rare gases exposed to alpha particles. This amplifying effect permits alpha scintillations to be observed in air at pressures near 1 atm, for fields greater than 1 kv/cm. The pulse height is a linear function of electric field, as for the rare gases. This result suggests that the scintillation is produced essentially by nitrogen. The response of Ar and Xe as functions of the electric field is shown for fields of 0 to 1.5 kv/cm. (T.F.H.)

23973 ANALYSIS OF TRACKS CREATED IN A LEAD-PLATE SPARK CHAMBER BY MONOKINETIC ELECTRONS WITH MOMENTA BETWEEN 500 AND 1400 Mev/c. G. Boella (Università, Milan), G. Degli-Antoni, C. Dilworth, L. Scarsi, G. Sironi, B. Agrinier, Y. Koechlin, and B. Parlier. p.49-55 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

A device consisting of a spark chamber with 5 lead plates (5 radiation lengths) was constructed for the study of the electron flux in primary cosmic radiation. For calibration, this device was placed in a beam of π^- from the Saturn synchroton. Short-period analysis showed that the beam contained several per cent of electrons. Negatives were taken of the tracks created in the chamber for various momenta between 500 and 1,500 Mev/c. In an initial experiment in which all tracks were recorded the proportion of electrons in the beam was determined by studying the statistical distribution of the beginning of the tracks in the chamber. In a subsequent experiment, a gas-type Cherenkov counter was used so that the chamber could be triggered by electrons only. The relationship between electron energy and the average number of sparks from the track produced by the electron in the chamber, gives a curve similar to that obtained by the calculations of H. Messel, et al. Analysis of the results of this experiment shows that within a certain energy range, such a device may be employed both as an electron discriminator and as a means of measuring electron energy. (auth)

23974 PULSE SHAPE DISCRIMINATION IN PROPORTIONAL COUNTERS. E. Mathieson and P. W. Sanford (Univ. of Leicester, Eng.). p.65-9 of "Nuclear Electronics." Paris, ENEA, 1964.

The rise time of the voltage signal in a proportional counter depends to some extent on the spatial distribution of the initial ionization, since initial electrons arrive at the multiplication region over a finite time interval. If this interval is comparable with the time of initial movement of the positive ions, the resultant pulse rise-time is measurably affected. It is shown that under certain conditions, therefore, further information concerning the incident particle, in addition to its energy loss, might be obtained from the output signal of a proportional counter. This proposal was applied to discriminate between low energy photons and high energy electrons depositing the same amount of energy in a counter. It has been possible to effect a significant reduction in the response of a counter to ^{60}Co radiation while leaving its response in the same energy range to ^{55}Fe x rays (6 kev) substantially unaltered. It is proposed to employ this scheme to reduce the background of an x-ray proportional counter in a space vehicle, where limited power and space prohibit the use of an elaborate anticoincidence counter arrangement. (auth)

23975 SOME RECENT ADVANCES IN ORGANIC SCINTILLATORS AND ČERENKOV DETECTORS. D. R. Nicoll and R. E. U. Routley (Nuclear Enterprises (G. B.), Ltd., Edinburgh). p.79-82 of "Nuclear Electronics." Paris, ENEA, 1964.

The development of liquid scintillators based on pseudocumene, α-methylnaphthalene, decalin, commercial solvents, and fully deuterated liquid scintillators is reported. Scintillating ion exchange resins developed for beta detection. Plastic scintillators loaded with lead to give increased response to x radiation and high-energy gamma radiation, and plastic Cherenkov detectors containing spectrum shifters and additives to quench the scintillations are discussed. (R.E.U.)

23976 SELF-TRIGGERING SPARK CHAMBER. A. Lansiart and J. Leloup (CEN, Saclay, France). p.83-6 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

A spark chamber for use in medical scintigraphy was developed. The aim was to replace devices using a mosaic of small scintillator crystals by a continuous detector giving much more light. The chamber works in a semiproportional manner at all times. The pulse received after impact of a gamma ray goes into a high-gain fast amplifier to produce the high-tension pulse that gives the spark. The influence that the nature of the gases used to fill the chamber and the pressure and the triggering delay have on image quality is discussed. (auth)

23977 APPLICATION OF SINGLE-PHOTOELECTRON TECHNIQUE TO DETERMINING THE DECAY-TIME CONSTANTS OF SCINTILLATORS. G. Pfeffer, H. Lami, G. Laustriat, and A. Coche (Centre de Recherches Nucleaires, Strasbourg). p.93-8 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

The so-called single-photoelectron technique is very suitable for detecting a very slight luminous emission and, in particular, for studying scintillators. After running over the conditions in which the greater majority of pulses are due to single photoelectrons, experimental proof is given of the validity of the technique. A device for determining the decay-time constants of liquid and plastic scintillators excited by nuclear radiation or by very short flashes of light is described. The principle of the time-to-amplitude converter used in this connection is also given. Results obtained with a number of scintillators dissolved in toluene are given, and the influence of the concentration of the solution on the time constant is demonstrated. (auth)

23978 STUDY OF THE TRANSFER OF EXCITATION IN LIQUID SCINTILLATORS BY SAMPLING INDIVIDUAL PHOTONS. Y. Koechlin and A. Raviart (CEN, Saclay, France). p.99-104 of "Nuclear Electronics," Paris, ENEA, 1964. (In French)

A method was developed for accurately determining the shape of scintillation pulses whose duration may be less than a nanosecond. An advantage of this method is the freedom from distortion due to the relatively lengthy pulse response of photomultipliers. The procedure is to take a sample in which the arrival of each photon is recorded separately and sorted according to its relation to the center of the luminous pulse. The pulse response of the device constructed on this principle shows a Gaussian distribution with a standard deviation of 0.3 nsec. This device was used in the study of the shape of scintillations in organic fluorescent solutions excited by α particles, β particles, or γ photons. The results obtained agree with the hypothesis of excitation energy transfer in organic scintillators. They permit accurate determination of the parameters in these hypotheses. (auth)

23979 NANOSECOND RESOLVING TIME OBTAINED WITH NaI(Tl) DETECTORS. M. Forte (Euratom C.C.R., Ispra, Italy). p.105-11 of "Nuclear Electronics." Paris, ENEA, 1964.

The resolving time that can be obtained with NaI(Tl) detectors was investigated by measuring resolving curves for ^{60}Co γ coincidences. The linear time-to-amplitude conversion technique used was required to work with the first few photoelectrons of a scintillation, in order to minimize the timing error, as predicted by current statistical theories. The circuit details allowed a reduced sensitivity to low pulses and a good stability ($\gtrsim 10^{-10}$ sec). A lower limit for the counter pulses was set by a slow coincidence. Coincidence curves obtained with a pair of 1.5 in. × 1 in. crystals, coupled to 56 AVP phototubes, indicated a single counter resolution (full width at half maximum) ranging from ~2 to 1 nsec. when the energy bias was varied from 220 to 660 kev. This is a fair approach to the theoretical limits, as estimated from the scintillator-photomultiplier statistics and after accounting for the pulse-height spread. (auth)

23980 FAST PHOTOMULTIPLIER WITH HIGH OUTPUT CURRENT AND WIDE LINEARITY RANGE. G. Breuze (CEA, Paris), J.-P. Fertin, and R. Petit. p.113-25 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

A fast photomultiplier with high output current and a wide linearity range was developed. This tube incorporates a photocathode of Cs_3Sb deposited on an opaque silver support and a multiplier with a focusing structure of six dynodes (Ag-Mg; Cs); the length of the photocathode and the dynodes is 25 mm. The construction of the tube is such that high voltages can be applied (7,500 v). At 6,700 v and with a gain of about 10^5, the linearity range is in the order of 3 amp, the rise time is 1.7×10^{-9} sec, and the overall transit times is 11×10^{-9} sec. Pulses with 6 amp peak are obtained. The design of the tube and the various stages of development from the P.M. 56 AVP, and the special methods of measurement used to determine the linearity range are described. (auth)

23981 SEMICONDUCTOR NUCLEAR PARTICLE DETECTORS. J. W. Mayer (Hughes Research Labs., Malibu, Calif.). p.129-46 of "Nuclear Electronics." Paris, ENEA, 1964.

In the past few years, the use of semiconductor particle detectors has been extended to β and γ ray spectroscopy as well as to higher energy nuclear reaction studies. This is primarily due to availability of deep drifted surface p-i-n structures and improvements in surface passivation. Particle identification has been facilitated by the development of thin, ΔE detectors. From the discussion of operating principles, the characteristics of the various types of detectors and their rise time and carrier collection efficiency can be deduced. The performance of semiconductor detectors is illustrated by their response to nuclear particles, including β and γ rays. Major areas of investigation are the understanding of irradiation effects and the development of new materials for γ spectroscopy. (auth)

23982 LITHIUM-DRIFTED SEMICONDUCTOR JUNCTION DETECTOR. G. Dearnaley (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and J. C. Lewis. p.147-53 of "Nuclear Electronics." Paris, ENEA, 1964.

A detailed description is given of a relatively simple technique for the preparation of semiconductor junction detectors, using the lithium ion-drift process to achieve sensitive volumes several mm. in thickness. By forming a surface-barrier on such compensated material, window thicknesses below 1 μ were easily obtained. Comparisons are drawn between this and previously published methods. Energy resolutions better than 60 kev for α and protons, and 25 kev for β, were obtained at room temperature. Investigations of the pulse rise times were carried out. (auth)

23983 RISE TIME OF PULSES PRODUCED IN SEMICONDUCTOR DETECTORS BY NUCLEAR RADIATIONS. P. Siffert, H. Rougeot, and A. Coche (Centre de Recherches Nucleaires, Strasbourg). p.155-62 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

The rise time of pulses from semiconductor detectors of the gold-silicon surface-barrier type was investigated. It was first of all demonstrated theoretically that the pulse-rise shape is governed by the sum of two exponentials, one being dependent on the collection of the charge carriers and the other on the circuit equivalent to the detectors. It was possible to show the existence of these two components experimentally. After determining the elements comprising the equivalent circuit, the rise-time values were calculated and these were compared with those measured for some sixty detectors made from silicon of different resistivities. (auth)

23984 RECENT DEVELOPMENTS IN E AND dE/dx SEMICONDUCTOR DETECTORS. C. N. Inskeep and W. W. Eidson (Indiana Univ., Bloomington). p.163-70 of "Nuclear Electronics." Paris, ENEA, 1964.

A number of investigations were carried out in connection with the development of E and dE/dx counters fabricated from p-type silicon. These studies were concerned with fabrication and testing, and with application to nuclear reaction studies. G. L. Miller has pointed out that surface barrier counters made from p-type silicon offer advantages over surface barrier counters made from n-type material. Rectifying surface barriers were produced on p-type silicon and tested in counting applications. These barriers were found capable of withstanding biases in excess of 1,200 v and to exhibit low ambient sensitivity. A convenient method for measuring junction depths as shallow as 0.1 micron was originated and used in a study of very shallow phosphorous junctions. Studies concerning the problems of surface stabilization and device encapsulation have resulted in the development of methods for producing counters with stable, low-noise surfaces. Methods for planar etching were developed together with other techniques for the production of very thin silicon wafers suitable for use as dE/dx detectors. The problem of inhibiting back contact injection in dE/dx detectors was solved with a simple barrier forming process. Counters were fabricated with thicknesses as small as 0.3 mil. Somewhat thicker transmission counters with active areas greater than 4 cm^2 were produced. Two mil-thick counters with active areas of 1 cm^2 have shown resolutions of 40 kev when tested with α-particles. (auth)

23985 A SEMICONDUCTOR COUNTER TELESCOPE FOR NEUTRON REACTION STUDIES. B. I. Lalović and V. S. Ajdačić (Inst. of Nuclear Sciences "Boris Kidric," Belgrade). p.171-80 of "Nuclear Electronics." Paris, ENEA, 1964.

A counter telescope, consisting of two or three semiconductor counters for analysis of dE/dx as a function of E, was made for studying nuclear reactions induced by

14.4-Mev neutrons. Various factors important for the telescope performance are discussed in detail and some solutions for obtaining the optimum resolution and a low background are given. Protons, deuterons, and α-particles resulting from scattering and reactions of 14.4-Mev neutrons on deuterium, tritium, praseodymium, and niobium were detected, and pulses from the counters recorded on a two-dimensional analyzer. These experiments have shown that the telescope compares favorably with other types of telescopes with regard to the upper limit of neutron flux which can be used, $\Delta E/\Delta x$ and E resolution, versatility, and compactness. (auth)

23986 MEASUREMENT OF FAST NEUTRON SPECTRA INSIDE REACTORS BY A LI^6 SEMICONDUCTOR COUNTER TELESCOPE. V. S. Ajdačić, B. I. Lalović, and B. P. Petrovic (Inst. of Nuclear Sciences "Boris Kidric," Belgrade). p.181-7 of "Nuclear Electronics." Paris, ENEA, 1964.

The possibility of using the ^{6}Li semiconductor counter spectrometer for measuring fast neutron spectra inside reactors was investigated in detail, and some solutions of the difficulties associated with the high interference of thermal neutrons in well-moderated reactors are suggested and checked experimentally. (auth)

23987 VERY THIN dE/dx SURFACE BARRIER SEMICONDUCTOR COUNTERS. M. D. Stojić and I. A. Slavić (Inst. of Nuclear Sciences "Boris Kidric," Belgrade). p.189-93 of "Nuclear Electronics." Paris, ENEA, 1964.

A method of preparing very thin dE/dx surface barrier detectors was developed. Using the described method dE/dx detectors as thin as 11 μ were obtained. Alpha particles from a Th(C + C′) source with energies of 8.78 and 6.07 Mev pass through such a thin detector losing only 1.06 and 1.50 Mev, respectively. These energy losses are detected as two well separated peaks with resolutions 8.5 and 6.5 per cent, respectively. (auth)

23988 AN EARTH SATELLITE EXPERIMENT FOR MEASURING THE CHARGE AND ENERGY SPECTRA OF THE PRIMARY COSMIC RAYS. G. H. Ludwig and F. B. McDonald (Goddard Space Flight Center, Greenbelt, Md.). p.195-204 of "Nuclear Electronics." Paris, ENEA, 1964.

An experiment was built to measure the energy spectra of the various nuclear constituents from protons through oxygen in the range ~15 to 90 Mev per nucleon. In addition it will provide a measurement of the electron spectrum in the energy range 2.3 to 20 Mev. It employs a 0.45 gm/cm^2 CsI scintillation detector to measure the rate of energy loss dE/dx, a 9 gm/cm^2 CsI scintillator to measure the total energy E, and a guard plastic scintillator to ensure that the particles come to rest in the total energy scintillator and to assist in defining the directional characteristics of the detector. Two-parameter analysis is employed to permit a complete mapping in E, dE/dx, and N. Signal conditioning equipment presents the data in proper form to the spacecraft central data handling system. A quasi-floating point digital counting system counts a number of pulse rates to serve as a check on the operation of the primary instrument and to facilitate dead-time correction. The instrument is assembled in the form of a 20 cm. cube, weighs 6.8 kg., and requires 1.6 w. of electrical power. The experiment is to be flown in mid-1964 on an Orbiting Geophysical Observatory, which will spend a major portion of its time near the apogee height of 110,000 km., well outside the earth's magnetosphere. A somewhat simpler version capable of studying particles Z < 3 will be flown in late 1963 on an Interplanetary Monitoring Platform, which will have an apogee height of 280,000 km. (auth)

23989 BETA- AND GAMMA-RAY SPECTROSCOPY BY USE OF SEMICONDUCTOR DETECTORS. Eiji Sakai (Japan Atomic Energy Research Inst., Tokyo). p.205-15 of "Nuclear Electronics." Paris, ENEA, 1964.

Detection efficiencies of silicon and germanium detectors of various dimensions for γ rays of various energies were calculated. Thick germanium detectors were made by the lithium-drift method. The pulse height distributions for γ rays and electrons were measured and compared with the calculations. Gamma-ray detections by detecting the external conversion electrons from high Z materials such as gold and lead were tried. Applications to the β- and γ-ray spectroscopy such as the measurements of conversion electron spectrum, β-ray spectrum, conversion electron-γ-ray coincidences, and conversion electron-conversion electron coincidences were performed in order to study the decay schemes of various isotopes. (auth)

23990 THE SOLID STATE DETECTOR AND ITS APPLICATION TO BETA SPECTROSCOPY. H. E. Bosch (IIAE, DINFIA, Buenos Aires), F. Krmpotic, and A. Plastino. p.217-28 of "Nuclear Electronics." Paris, ENEA, 1964.

An arrangement for detection of electrons and electron-γ coincidence was mounted. Several counters were used and the corresponding absolute efficiency as a function of the energy was determined. Attempts were made to measure internal conversion coefficients of different transitions corresponding to ^{93m}Mo, ^{203}Tl, and ^{202m}Pb. The results indicate in general a good agreement with respect to the theoretical values, within an error of about 7 per cent. In addition, an electron-γ angular correlation arrangement was set up, replacing a magnetic spectrometer by a solid state counter. Experiments on the cascade γ (0.4 Mev)-electron (0.279 Mev) belonging to ^{203}Tl were performed. The results indicate agreement with the measurements of Deutch and Goldberg, and also with those of Gerholm and co-workers. (auth)

23991 METAL-SEMICONDUCTOR CONTACTS FOR SOLID STATE RADIATION DETECTORS. P. E. Gibbons (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.243-9 of "Nuclear Electronics." Paris, ENEA, 1964. (AERE-R-4473)

The mode of operation of the gold–silicon surface-barrier diode is discussed. Certain experimental observations pertaining to this contact are given. The roles of oxygen and water in producing good reverse characteristics are suggested to be as passivating agents in solving the problem of dangling bonds. (auth)

23992 MEASUREMENT OF γ RADIATION IN A ROCKET DURING ITS FLIGHT THROUGH AND ABOVE THE EARTH'S ATMOSPHERE. D. Boclet, G. Ducros, J. Labeyrie, and R. Rocchia (CEN, Saclay, France). p.251-8 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

Equipment is described that may be fitted into a rocket and is capable of selecting and measuring ambient radiation in the presence of proton and electron radiation. Using an ordinary telemetry channel this equipment transmits to the ground information concerning a count of events, and an analysis of the pulse height spectrum of these events. The corresponding signals are sent to the transmitter in a digital code and thus no error is introduced even though there may be radio interference. On the ground, recording on a tape likewise, cannot affect the accuracy of measurement. The code employed is intended primarily for the measurement of the pulse-height spectrum. The overall error is as low as one per cent. This equipment, sent up in a "Veronique" rocket, has shown up the 511-kev peak of cosmic electron-positron annihilation of the γ-albedo above the atmosphere. (auth)

23993 HIGH COUNTING RATE dE/dx PLASTIC SCINTILLATION COUNTERS FOR PULSED ACCELERATORS. V. Agoritsas and J. A. Geibel (CERN, Geneva). p.259-71 of "Nuclear Electronics." Paris, ENEA, 1964.

Scintillation counters cover a very large range of applications in detecting nuclear radiation phenomena in low- and high-energy physics. From the application point of view scintillation counters can be divided into two classes: E-scintillation counters for spectroscopy purposes, and dE/dx-scintillation counters for counting the radiation intensity, without interfering appreciably with the beam of the counted particles. A description of the second class of plastic scintillation counters, called sometimes "transmission counters" is given. A series of these counters was developed for use in studying the very intense secondary particle beams of the 25-Bev CPS (CERN Proton Synchrotron), taking in consideration the very special counting conditions around the pulsed accelerator. The main use of these is beam profile measurements during beam transport studies and internal target relative efficiency monitors. Results of these applications are given. In general they are used in pairs feeding coincidence circuits and forming beam telescopes for simultaneous discrimination of the counted particles in time and space. Counting rates of the order of 10^7 particles per second were registered without noticeable losses. (auth)

23994 TRANSISTORIZED PULSE SHAPE n-γ DISCRIMINATOR. E. Elad and S. Rozen (Israel Atomic Energy Commission, Tel-Aviv). p.299-308 of "Nuclear Electronics." Paris, ENEA, 1964.

A transistorized pulse-shape discriminator is described, which permits the detection of fast neutrons in the presence of a γ-ray background at high counting rates. The operation of the discriminator is based on the comparison of the charge collected from a scintillation sample with the peak of the scintillation. The optimum values of the sample parameters, i.e., width and delay from the scintillation peak, were deduced after studying the shape of the pulses obtained with an anthracene scintillator. The main advantages of the discriminator are: a high γ-ray rejection ratio, a wide dynamic range (1:10), the use of only a single dynode output and a noncritical method of γ-ray rejection adjustment by a single control. The system was used in a fast-neutron time-of-flight measurement. (auth)

23995 TIME AND AMPLITUDE MEASUREMENT SYSTEM. A. Basire, B. de Cosnac, and J. Labbé (CEA, Paris). p.325-32 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

A time and amplitude measurement system was produced that is designed to work with photomultipliers or solid-state detectors. In both cases, the amplitude of the detector signal is maintained. The apparatus consists of four parts: preamplifiers, for use only with solid detectors; pulse-correction circuit to preserve the time function, whatever the amplitude of the signal; coincidences selector to set the converter; and time-amplitude converter to measure the time interval between the two pulses that produced the coincidence. A sliding magnifier may be added, to analyze the amplitude of the signals. With photomultipliers, a resolution of 0.5 nsec. on the γ-γ coincidence of cobalt 60 was detained. A resolution of 1.5 nsec was obtained between a neutron and its associated alpha particle in a T (d,n) alpha reaction produced by an accelerator, where the alpha particle was detected by a junction diode. (auth)

23996 PITCH CHANGE PROGRAMME OF PULSE TRAINS; APPLICATION TO NEUTRON TIME-OF-FLIGHT MEASUREMENT. J. Thenard and G. Victor (CEN, Saclay, France). p.333-9 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

Two methods used for varying the channel width of a time coder according to a program are described. The first method is based on the use of a binary scaler in which it is possible to vary the number of useful trigger circuits without disturbing operation. This method has already been applied in the construction of a time coder (variation range 50 to 3.2 nsec.). For a faster unit, it was thought preferable to sample the clock train by means of different positions of a ring. Combinations of these positions are program-selected to obtain a modified train whose period varies between 10 and 80 nsec. (auth)

23997 MEASURING EQUIPMENT FOR SEMICONDUCTOR DETECTORS. J. L. Lecomte (CEA, Paris). p.341-7 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

The production of semiconductor detectors having reached the industrial stage, it is considered necessary to design measuring equipment for use with such detectors, especially in the field of α spectrometry, which could likewise be produced by industry. The fully-transistorized equipment described is basically a low-noise amplifier; it forms the essential link between the detector and a multichannel analyzer. It consists of a low-noise preamplifier (10 kev) and amplifier equipment comprising an amplifier with an RC shaping circuit; a linear gate; a stretcher; an amplifier with threshold; a discriminator; and a supply point for polarizing the detector. The theoretical aspects of noise in a transistorized pre-amplifier, and the different circuits employed and their performance are discussed. (auth)

23998 A PROGRAMME FOR AUTOMATIC SCANNING OF SPARK CHAMBER FILM. P. M. Blackall, G. R. Macleod, and P. Zanella (CERN, Geneva). p.357-64 of "Nuclear Electronics." Paris, ENEA, 1964.

A system for the automatic scanning and analysis of spark chamber pictures is being put into operation at CERN to process some 250,000 pictures taken during a π-p elastic scattering experiment run at the CERN PS. The equipment consists of a flying spot digitizer on-line with an IBM-7090 computer. A computer program controls the digitizer and carries out all the operations necessary for the scanning of the film and for the analysis of the interesting frames. It consists of a set of FORTRAN/FAP subroutines the majority of which are independent of the format of the pictures being analyzed. The most interesting aspects of this automatic handling of photographic data are described. (auth)

23999 A SOLID STATE TRIGGER UNIT FOR SONIC SPARK CHAMBERS. C. A. Stråhlbrandt (CERN, Geneva). p.365-70 of "Nuclear Electronics." Paris, ENEA, 1964.

A solid-state unit, designed to trigger sonic spark chambers is described and discussed. It has been shown to operate reliably during long periods, with a timing jitter < ±15 nsec. The circuit will be used in an experiment on small angle p-p elastic and inelastic scattering. (auth)

24000 THE USE OF SONIC SPARK CHAMBERS AND DATA HANDLING TECHNIQUES IN A SCATTERING EXPERIMENT. C. Whitehead (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.379-89 of "Nuclear Electronics." Paris, ENEA, 1964.

Details are given of an experiment involving the use of sonic spark chambers to study the reaction $d + {}^{12}O \rightarrow d + {}^{12}C$ at 70 Mev. A data handling system in the form of a

16 × 16 magnetic memory matrix was used to record the information from 10 microphones and also pulse-height information. Preliminary results of the experiment are given. (auth)

24001 USE OF CLOSED-LOOP MAGNETIC RECORDING FOR ANALYZING EVENTS DISTRIBUTED ERRATICALLY IN TIME, AND ITS APPLICATION TO THE MEASUREMENT OF GAMMA-RAY SPECTRA. P. Simonet and J. Maragnon (CEA, Paris). p.391-9 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

A method of magnetic recording using a closed loop whereby it is possible to record, in coded form, data relating to events that occur erratically is described. The frequency of concurrence of the events may vary widely. The duration of recording depends on the time needed to obtain a set of data meeting requirements from the standpoint of statistics. The recorded data are read by means of a suitable decoder. The duration of reading is fixed, being the time required for the entire loop to travel past the decoder. It is shown that the probability of superimposing one set of data on another during the successive passages of the loop past the recording heads can be kept sufficiently low by selecting a suitable length of loop, and a suitable transport speed, in the light of the set of statistics required. As an example, this method is applied to the recording of gamma-ray spectra over periods of time varying between 500 and 10^6 sec with a reading speed of 250 sec on a multichannel analyzer. (auth)

24002 DEVICE FOR IONIZATION MEASUREMENTS OF ELEMENTARY PARTICLE TRACKS ON BUBBLE CHAMBER FILM AND EMULSION. E. Lorenz (Max-Planck Institut, Munich). p.457-61 of "Nuclear Electronics." Paris, ENEA, 1964.

The differential gap length distribution is determined to obtain the middle gap density as are other ionization parameters such as blob density, lacunarity, or blob length distribution. Evaluation within the bubble chamber is fully automatic. After slight changes the device can be used for semiautomatic ionization measurements in emulsions. (auth)

24003 DEVICE FOR MULTIPLE SCATTERING MEASUREMENTS AND TRACK CURVATURES IN NUCLEAR EMULSIONS. M. Bott-Bodenhausen (Max-Planck Institut Munich). p.463-6 of "Nuclear Electronics." Paris, ENEA, 1964.

The circuitry for analyzing nuclear emulsions is described. An eyepiece-micrometer with rotating disk and pulse discriminator is used in conjunction with a computer operating by two calculating modes with circuitry for transfer from one store into another, subtraction, and binary to decimal transfer. (R.E.U.)

24004 USE OF DIGITAL TECHNIQUES IN NEUTRON EXPERIMENTS IN A REACTOR. P. Vergez (CEN, Saclay, France). p.467-71 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

As a result of improvements in pulse detectors for thermal neutrons, greater accuracy can now be achieved in counting and sampling techniques than was possible with nonpulse types. Instruments based on this method of measurement and their design involve the solution of three types of problem. (1) Detection and counting. Accuracy of measurement is related to the counting rate, which should be as high as possible. The latter is at present limited only by the detectors, resolution times of the order of 10 nanoseconds being possible with standard electronic equipment. (2) Arrangement and form of data. The large quantity of data obtained is analyzed on a digital computer. The data must therefore be put into a form which can be readily assimilated by the computer. (3) Tests. In view of the complexity and particularly the size of these machines, it is necessary to have a specialized testing system to ensure that all the circuits are operating correctly. (auth)

24005 ANALOGUE SPECTRUM STRIPPING IN MULTICHANNEL PULSE HEIGHT ANALYZERS. F. Bregman (Philips Gloeilampenfabrieken, Eindhoven, Netherlands). p.473-6 of "Nuclear Electronics." Paris, ENEA, 1964.

Spectrum stripping offers the possibility of multiplying a (standard) spectrum, stored in a part of the kicksorter's memory, by a suitable weighting factor and subtracting it from data, newly accumulated in another memory part. To offer this feature, two extra capabilities of the kicksorter's computer, that is multiplication and subtraction of numbers, are required. Spectrum stripping, employing analog instead of the digital techniques mentioned above, is introduced. Instead of the binary signals from the memory, the analog spectrum stripper handles the analog signals from the kicksorter's digital-to-analog converter; consequently the necessary multiplication and subtraction can be performed by a variable gain and a difference amplifier. The characteristics of both methods of spectrum stripping are illustrated. (auth)

24006 AN ELECTRONIC SYSTEM FOR THE DETECTION OF LAMBDA HYPERONS. K. Lande, A. K. Mann, and D. H. White (Univ. of Pennsylvania, Philadelphia). p.477-83 of "Nuclear Electronics." Paris, ENEA, 1964.

The performance of an electronic system employing a high efficiency anticoincidence counter, differential ionization information, and time-of-flight to preferentially select Λ hyperons is discussed. Data are presented on the effect of each logical constraint in reducing background. In addition the ability of the system to select Λ hyperons in a restricted angular range using the time-of-flight condition is demonstrated. (auth)

24007 COLLIMATION OF ALPHA PARTICLES IN AN IONIZATION CHAMBER. R. Benoit, G. Bertolini, and G. B. Restelli (Euratom CCR, Ispra, Italy). p.485-95 of "Nuclear Electronics." Paris, ENEA, 1964.

Different types of mechanical and electronic collimation of α particles in a grid ionization chamber are compared. A new method of electronic collimation based on the different time-of-flight of the center of mass of the electrons along the ionization track, normalized with respect to the α energies, is presented. The low energy tail associated with the α peak decreases by a factor of up to three without perturbing the peak intensities. The transmission of the collimation system is about 30 per cent. A mixture of Ar + 2 per cent C_2H_2 was successfully used, and the drift velocities for X/P from 0.030 to 0.23 vcm^{-1} mm^{-1} Hg was measured. (auth)

24008 FAST NEUTRON SPECTROSCOPE FOR MEASUREMENTS IN A HIGH INTENSITY TIME DEPENDENT NEUTRON ENVIRONMENT. S. Kronenberg (Army Electronics Research and Development Lab., Fort Monmouth, N. J.). p.505-11 of "Nuclear Electronics." Paris, ENEA, 1964.

In the modern research on pulsed reactors and other pulsed nuclear radiation sources, it is important to know the spectrum of fast neutrons in the environment of the source and how this spectrum varies with time during and after the pulse. Neutron spectroscopy as a function of time, using techniques of the single particle energy analysis, can not be applied because at high intensities it is not possible to resolve the single particles. A device operating on the collective contribution of particles scattered by fast neutrons was designed and developed. It is designed to measure neutron spectra between the energies of several hundreds kev and several tens Mev when these neutrons are delivered at rates between 10^{26} and 10^{16} n cm^{-2} sec^{-1}. It can be modified for the fluxes between 10^{16} to 10^{9} n cm^{-2} sec^{-1} and for 10^{9} to 10^{4} n cm^{-2} sec^{-1}. The device may be constructed with a very high time-resolution of about 10^{-9} sec and is therefore capable of measuring a fast neutron spectrum as a function of time when this spectrum is rapidly changing with time. The instrument can be made sensitive to fast neutrons and insensitive to α radiation and β rays thus making it operative in a mixed radiation environment. (auth)

24009 A FULLY AUTOMATED COMPUTER CONTROLLED SYSTEM APPLIED TO NEUTRON SPECTROMETRY. E. de Agostino and B. Turko (CNEN, Rome). p.513-18 of "Nuclear Electronics." Paris, ENEA, 1964.

The system is intended to work with a 1620 type IBM Data Processing System, which prepares the instructions for spectrometer operation on punched tape. The measured data and all necessary instructions are printed out and punched on tape, ready for final treatment using the IBM 1620. Each instruction, read from the tape, is self-contained and independent from both previous and subsequent ones. Each instruction includes one code, determining the sequence of spectrometer operation, a numerical information and the start-of-execution command. A series of instructions constitutes a program. Two instructions of each program are reserved for the direct data transfer necessary to the Data Processing System from input to output punched tape. Additional new programs are possible by relatively simple modifications. The sample table, the counter arm, and the monochromator of the spectrometer can be positioned independently to a predetermined angle with a precision of 0.01° using three Coleman Digitizers. They run automatically to this angle from any position, but always approach it from the minor angle direction, in this way eliminating the error of the mechanical system. Automatic scanning in both directions is possible for any of three digitalized variables. Scanning-step width is also digitalized and can be preset to any value. Both the digitizer position and the destined angle stored as well as the respective code are continuously displayed. (auth)

24010 TRANSMISSION OF INFORMATION STORED IN MULTICHANNEL ANALYZERS INTO COMPUTER. G. I. Zabyakin, V. N. Zamry, and V. N. Semashko (Joint Inst. for Nuclear Research, Dubna, USSR). p.565-8 of "Nuclear Electronics." Paris, ENEA, 1964.

A system for automatic transmission of experimental data stored in a multichannel analyzer is described. Data are transferred from the analyzer, via a cable, and recorded on one of the magnetic tape recorders of the computer, independent of the computer operation. To check information transfer and feeding, the all-channels datasum is made. The transmission and comparison of checksums take place. (auth)

24011 INTERMEDIATE MEMORY IN PULSE CONDITIONS. G. I. Zabiyakin and G. A. Ososkov (Joint Inst. for Nuclear Research, Dubna, USSR). p.569-73 of "Nuclear Electronics." Paris, ENEA, 1964.

The problems of using an intermediate memory in recording devices of time- and multidimensional-type analyzers in pulse conditions are considered. An analysis of operation modes of such systems is carried out. The results of the analysis are shown in diagrams that enable one to estimate the necessary capacity of the intermediate memory and base memory fast acting, depending on the recorded event density and duty-ratio of the system operation. It is shown that in pulse conditions it is possible to use relatively slow systems as a basic memory (magnetic tape) in a few thousand channels time- or multidimensional-analyzers. In this case the intermediate memory must have a larger capacity than the usual one to provide double derandomizing conditions of statistical information. (auth)

24012 SOME PECULIARITIES OF A MAGNETIC-TAPE MULTIDIMENSIONAL ANALYZER. G. P. Zhukov, G. I. Zabiyakin, and V. D. Shibaev (Joint Inst. for Nuclear Research, Dubna, USSR). p.575-80 of "Nuclear Electronics." Paris, ENEA, 1964.

Some peculiarities of a magnetic-tape multidimensional analyzer related with the introduction of a magnetic-tape information recording check and visual observation of the information collection with the aid of an oscillographic indicator checking memory are considered. The peculiarities of two intermediate memories operating alternatively are considered. (auth)

24013 THE USE OF A PHOTOMULTIPLIER AS AN ELEMENT OF COINCIDENCE SELECTION. M. Vysochanskii, S. V. Mukhin, S. V. Rikhvitskii, I. N. Semenyushkin, and I. Foltin (Joint Inst. for Nuclear Research, Dubna, USSR). p.581-6 of "Nuclear Electronics." Paris, ENEA, 1964.

Minimization of time jitter at the output of a photomultiplier circuit to reduce the effects on the resolving time of a coincidence circuit is discussed. The operation of a photomultiplier with a control electrode within acting as the element of coincidence selection is discussed. (R.E.U.)

24014 FAST ELECTRONICS APPLIED TO NUCLEAR PHYSICS. I. Pizer (CERN, Geneva). p.603-6 of "Nuclear Electronics." Paris, ENEA, 1964.

Coincidence circuits, scaler circuits, amplifiers, and photomultipliers and their uses because of rapid rise-time, short operating times, or narrow time resolutions are discussed. 31 references. (R.E.U.)

24015 FAST ELECTRONIC EQUIPMENT USED IN THE MEASUREMENT OF FISSION CROSS-SECTIONS. G. Fraysse, A. Prosdocimi, and J. Winter (Euratom, Ispra, Italy). p.607-17 of "Nuclear Electronics." Paris, ENEA, 1964.

The availability of detectors producing very short pulses has profoundly changed experiments measuring fission cross sections of isotopes with high specific α activity. The two criteria for the electronic equipment employed are: that is should have an extremely short resolution time; and that it should have an extremely high counting rate. Most of the fast circuits developed up to the present time only satisfy the second condition somewhat imperfectly. Having analyzed the problems associated with the detectors, special semiconductor circuits were designed and constructed. They include: tunnel diode discriminators with constant dead time. The performances of these circuits are given and discussed. (Pulse-height resolution, linearity, sensitivity, time resolution and "jitter"); nanosecond pulses are analyzed by means of a standard multichannel analyzer by the use of a lengthener circuit, which reduces the high input counting rate (10^{7}/s) and continuously adjusts from a "load sensitive" to an "amplitude sensitive" mode of operation. The advantages and limitations of this circuit are discussed. The "fast coincidence" unit of a classical tunnel diode type was constructed. Its resolution, limited by the different fluctuations in the information provided by the photomultiplier, is discussed. Circuits of these types allow "fast-fast" arrangements to be employed, thus eliminating certain disadvantages of "fast-slow" arrangements. The experimental rigs used and the overall performances are discussed. (auth)

24016 NANOSECOND TIME SELECTOR WITH TIME-TO-AMPLITUDE CONVERSION AND PRESELECTION. R. Van Zurk (CEA, Paris). p.619-27 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

The time selector described will only operate after preselection is effected by a parallel fast channel. The selector is based on the time-to-amplitude conversion principle and makes use of semiconductors with tunnel diodes for the principal functions. Its principal characteristics are discussed. (auth)

24017 TRANSISTORIZED TIME-TO-AMPLITUDE CONVERTER. P. Vergezac and J. Kahane (College de France, Paris). p.629-31 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

Transistorized equipment was constructed for measuring the time spacing between two weak pulses. One of the channels receives data from a silicon p-n junction that is used as a radiation detector and is followed by an amplifier. A resolution of 3 to 4 nsec is obtained with a 50-nsec field of measurement, and linearity is very satisfactory. This time-to-pulse-height converter provides measurements of time interval, up to 100 nsec between two negatives 300 mv pulses. The electronic resolution is better than 0.1 nsec. (auth)

24018 A NANOSECOND TIME CODER WITH LARGE ANALYSIS RANGE FOR TIME-OF-FLIGHT EXPERIMENTS. H. Meyer (Euratom, Ispra, Italy). p.633-42 of "Nuclear Electronics." Paris, ENEA, 1964.

A nanosecond time coder for "real time" or "delayed time" time-of-flight analysis was built with a minimum channel width of 1 nsec and a maximum possible channel number, for a time accuracy of one channel, of 2^{13}. The unit is a chronotron type system. Active elements used are tunnel diodes and transistors. The equipment layout is described. (auth)

24019 TRANSISTORIZED TIME CODER OF 10 NANOSECONDS PER CHANNEL. P. Durand and P. Giraud. p.643-50 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

A transistorized time coder was designed for Euratom. The specifications and characteristics of this unit represent a synthesis of the ideas of Euratom and the French C.E.A. (Saclay). The coder has a high accuracy (10 nsec per channel, with a jitter of ±1.5 nsec), high analysis capacity (maximum 65,536 channels) and low resolution time (about 200 nsec), which can be utilized by virtue of the low access time of the memory unit; other features are ease of operation and programming. The coder has 4 input circuits and analysis is programmed by zones (up to 4 nonadjacent or 8 adjacent zones), defined in both position and duration by decimal labeling. The coder also has an "accordeon" variable channel-width device developed in collaboration with the C.E.A., which allows the optimum channel width to be used in each zone. The fast circuits are described with special reference to the T_0 signal phase-control circuits, and the rapid address with flight reading, which governs the accuracy of the apparatus. (auth)

24020 A TRANSISTORIZED TIME CODER WITH SEVERAL THOUSAND CHANNELS OF ONE NANOSECOND WIDTH. P. Durand (Societe Intertechnique, Plaisir, France), P. Giraud, G. Brudermueller, and B. Reuter. p.651-5 of "Nuclear Electronics." Paris, ENEA, 1964.

With modern Van de Graaff accelerators, it is possible to obtain protons or deuterons in bursts of 1 and even 0.5 nsec. Nuclear cross sections, for example, may be measured on such machines, with greatly improved accuracy, provided that the coders used have a similar performance. The characteristics and the working principle of the HC 98 coder were developed for this purpose; fully transistorized instrument, minimum channel width: 1 nsec, very high maximum number of channels: up to 17 binary characters available, very low analysis dead time: 200 to 300 nsec, flexibility of operation: 4 simultaneous channels with initial delay by digital labeling. The coder works on an original principle that gives an accuracy identical to that of a conventional coder with a clock frequency of 1,000 MHz (jitter ±0.5 nsec), without having the limitation as regards dead time or the number of channels that are found in vernier or time-to-amplitude coders. Measurement is carried out in two stages: coarse coding to within 10 nsec followed by fine coding by interpolation to within 1 nsec. The T_0 and neutron signals are handled in the same way. The working principle and the fast circuits are described. (auth)

24021 USE OF STORAGE TUBES FOR HIGH SPEED PULSE AMPLITUDE ANALYSIS. J. S. Austin (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.667-77 of "Nuclear Electronics." Paris, ENEA, 1964. (AERE-R-4394)

A barrier grid storage tube is used as a temporary store of pulse amplitudes in analog form with a dead time of 2 μsec for each recorded pulse. On read-out the amplitudes can be presented to an analyzer either in analog form or encoded into pulse trains in the familiar manner of most amplitude-to-digital converters. Correlation between pulses can be retained. A core matrix store can be used with the storage tube to record digital information associated with the pulses. (auth)

24022 A 100 MHz DIGITAL TIME-OF-FLIGHT SYSTEM. J. K. Whittaker and P. Cavanagh (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.679-84 of "Nuclear Electronics." Paris, ENEA, 1964. (AERE-NP/Gen-32)

In the nanosecond time-of-flight technique used for measuring particle energies it is frequently necessary to determine flight times of many μsec duration with a very high time resolution. A 100 MHz digital time-of-flight analyzer which provides 4,096 channels each of 10 nsec duration is described. The system consists of the following basic units: a crystal-controlled 100-MHz oscillator; a control unit in which all gating functions are performed; a 100-MHz tunnel diode scaler; and a 4,096 digital magnetic tape recorder that is used to store the binary information from the 100-MHz scaler. The major advantages of such a digital system are an excellent linearity and a timing range limited only by the number of channels available in the magnetic store. Common faults of fast digital scaling systems such as periodic variations in the number of counts per channel due to differential input sensitivity of the scaler binaries to successive pulses were overcome by thorough setting-up and testing. The analyzer was satisfactorily used for several months in conjunction with the Harwell linear electron. The observed energy spectrum of neutrons from the reaction $^{16}O(\gamma,n)^{15}O$ clearly demonstrates the performance of the analyzer. (auth)

24023 HIGH SPEED MEASUREMENTS WITH SILICON JUNCTION NUCLEAR PARTICLE DETECTORS. H. S. Katzenstein and R. M. Alexander (Solid State Radiations, Inc., Los Angeles). p.685-92 of "Nuclear Electronics." Paris, ENEA, 1964.

The time response of silicon junction detectors is limited by the field that can be applied to the junction and the limiting velocity of charge carriers. In low resistivity p-n detectors and totally depleted p-i-n units, pulse rise-times of less than 10^{-9} sec were observed. For large depletion regions in high resistivity p-n junction detectors and thick lithium ion-drift detectors rise-times may range as high as several hundred nanoseconds. In many cases, the detector lead-in and preamplifier bandwidth represents limiting factors in high-speed measurements. A low-noise, high-impedance preamplifier with a rise time of 2×10^{-9} sec was constructed, permitting measurements down to 10^{-9} sec to be made on random counting signals. For timing of minimum ionizing particles an optimum detector depth is indicated in which detector capacitance, charge carrier collection time, amplifier rise time, and noise must all be taken into account. (auth)

24024 A FAST, LOW NOISE AMPLIFIER DESIGNED FOR USE WITH He^3 AND/OR Li^6 SOLID STATE DETECTORS OPERATING IN REACTOR ENVIRONMENTS. K. Nygaard (Aktiebolaget Atomenergi, Stockholm). p.693-7 of "Nuclear Electronics." Paris, ENEA, 1964.

The use of ^3He and ^6Li solid state sandwich detectors in reactors has been restricted by bad resolution caused by γ radiation. Fast, low noise amplifiers expand the useful field of application of the detectors. A completely transistorized amplifier, having a time resolution of 10 nsec and an energy resolution of 70 kev when used with a 50 pf solid state Si detector situated at the end of a 6 m coaxial cable, is described together with some experimental results. (auth)

24025 A METHOD OF MEASURING ULTRA-SHORT NUCLEAR LIFE-TIMES USING PARTICLE TIME TO ENERGY CONVERSION WITH A HF VOLTAGE AND ENERGY SELECTION BY SOLID STATE DETECTORS. P. A. Tove and L. G. Jonasson (Uppsala Univ.). p.699-719 cf "Nuclear Electronics." Paris, ENEA, 1964.

A method of measuring ultra-shortlived nuclear states fed and de-excited by transitions giving conversion electrons is discussed. The conversion electrons obtain different energy increments by passing through a microwave cavity gap and are detected in energy-selective solid state detectors. A time delay between the feeding and de-exciting electrons gives a deformation of the correlated pulse height spectra of the two conversion lines. The principle was tested using the h-f deformation of the sum line created in a detector by the cascade in ^{123m}Te that shows a life-time of 1.9×10^{-10} sec. The method has potentialities for measuring half-lives down to or below 10^{-12} sec. (auth)

24026 TWO CIRCUIT MODULES OF AN AUTOMATIC PULSE SELECTION AND REGISTRATION UNIT FOR 100 MEGAPULSES/S. M. Coli (CNEN, Frascati, Italy) and A. Serra. p. 731-9 of "Nuclear Electronics." Paris, ENEA, 1964.

Fast coincidence circuitry with anticoincidence and a resolving time of less than 2 nsec and a current linear gate with linearity better than 1 per cent for pulses of 1 to 20 mamp amplitude that belong to an automatic pulse selection and registration unit with dead time less than 10 nsec are described. (R.E.U.)

24027 HIGH-RECURRENCE NANOSECOND PULSE GENERATOR. J.-J. Samueli and P. Raimbault (Société d'Electronique Industrielle and Nucléaire, Paris). p.741-5 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

A nanosecond pulse generator incorporating avalanche transistors, with which it is possible to obtain rectangular or exponential signals up to a recurrence of 10 MHz, is described. The signals have a maximum amplitude of 10 v with a load resistance of 50 ohms and a rise-time of the order of 0.5 nsec. Two channels are available in addition to an output trigger. Trigger-signal lead and phase shift between the two channels are adjustable within a range of 50 nsec. (auth)

24028 NANOSECOND PULSE AMPLIFIERS. A. Lavaitte (CEA, Paris). p.761-8 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

The amplifiers were designed mainly for the study of semiconductor detectors, the most important information being that concerning time. Two amplifiers were constructed, one with a gain of 10 and the other a gain of 40 (in voltage) with input and output impedances of 50 ohms. Their respective rise-times (without overshoot) are 2.2 and 2.8 nsec. The two amplifiers may be used in series, when there is a gain of 400 and a rise-time of 3.5 nsec. Each circuit is on a single printed board (96 × 115 mm) with copper on both faces. The input and output are through 50-ohm printed lines and the system is suitable for 2 × 18-pin connectors. The basic arrangement of these amplifiers is a cascode, separated by emitter-followers which lower the impedance and have the following advantages: separation of input and output; elimination of Miller capacitance; and the current-controlled transistors with earthed bases have a cut-off frequency in the region of f_c for their input circuit. (auth)

24029 PULSE COUNTING AND MEASUREMENT AT 100 MHz AND ABOVE. P. Lebail (Compagnie Générale d'Electricité, Paris). p.769-78 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

The requirements of nuclear physics have led to the development of various counters with a time resolution of 10 nsec or less. The problems associated with binary and decimal counting circuits, and fast discriminators with low dead times suitable for use with these circuits, are considered. Counting and discriminating circuits with resolutions around 2 nsec are then described, together with pulse generators and the methods of measurement that have made their development possible. Fields opened up by sub-nanosecond pulse electronics are dealt with. (auth)

24030 PRE-SCALER WITH 10 ns RESOLVING TIME. R. Peincenat (Compagnie Francaise Thomson-Houston, France). p.779-83 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

A scaler circuit is described that consists of an input circuit, a scaler, and a binary and decimal output. The circuit has a resolving time of 10 nsec. (T.F.H.)

24031 TUNNEL DIODE LOW LEVEL DISCRIMINATOR. E. du Blust (CCR Euratom, Ispra, Italy), V. Mandl, and I. de Lotto. p.785-92 of "Nuclear Electronics." Paris, ENEA, 1964.

A fast low-level pulse-height discriminator that may be operated directly with solid state detectors was developed. A preliminary analysis of the characteristics of the different tunnel diode switching circuits is given. The circuit presented has a good linearity, fast switching, and short recovery time. The input sensitivity at the lowest threshold level is 20 μamp across a 50 ohm input impedance and for signals of 10 nsec width. Good temperature stability is assured with a simple thermostat. (auth)

24032 RECENT IMPROVEMENTS IN PHOTOMULTIPLIERS FOR USE IN NUCLEAR PHYSICS. G. Pietri, J. Nussli, and M. Brault (Laboratories d'Electronique et de Physique Appliquee, Paris). p.793-805 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

Improvements in the technical aspects of tube manufacture and in the systematic study of the statistical aspects of the processes concerning the operation of the photomultiplier are discussed. (auth)

24033 ANODE-CURRENT PULSE SHAPE OF THE RCA CENTRAL-POTENTIAL MULTIPLIER PHOTOTUBE C 70045 A. Q. Kerns (Univ. of California, Berkeley). p.807-9 of "Nuclear Electronics." Paris, ENEA, 1964.

The C 70045 A is a 14-stage side-window multiplier tube with a semitransparent S-11 photocathode. Observed pulse shapes under various types of pulsed illuminations are reported. (R.E.U.)

24034 GAIN STABILIZATION OF ANALOGUE AMPLIFIERS IN THE NANOSECOND REGIME. K. G. Porges and J. Bjorkland (Argonne National Lab., Ill.). p.811-18 of "Nuclear Electronics." Paris, ENEA, 1964.

In the amplification of pulse from fast-responding nuclear detectors to pulse heights acceptable to fast discriminators, long-term gain stabilization has been very difficult to achieve when the required bandwidth is large enough to prohibit degenerative feedback. A method was developed that provides regulation of the amplifier and discriminator, through periodic test pulses. The electronic circuits used in this device are all digital, hence very stable over long periods of operation. The same method, with minor modifications, can be used to stabilize photomultipliers or slow amplifiers as well, when stability of the highest quality is required. Test pulses may be injected as current pulses into the input grid capacity of the counting channel, or as light pulses into the photomultiplier (in scintillation counting). The gain stability is limited only by the stability of the test pulses, and by system noise. Preliminary results on a CW method of superregulation of distributed amplifiers, in which a low-frequency signal is mixed with the nuclear detector pulses, are briefly discussed. (auth)

24035 100-CHANNEL, 500 NANOSECOND ANALOGUE-TO-DIGITAL CONVERTER. R. Arnal and R. Borchi (Institut National des Sciences Appliques de Villeurbanne, France). p.819-28 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

With the appearance of memories with cycle times of several hundred nanoseconds in multichannel analyzers, an analog-to-digital converter that will work in an equivalent time is necessary. A 100-channel converter was constructed with a maximum conversion time of 500 nsec. The instrument works on the Mac-Mahon principle; it owes its speed mainly to a square wave generator with a rise time and a fall time of 1 nsec, and a repetition frequency of 50 MHz that can rise to more than 100 MHz. Conversion is affected by charging a capacitor through a linear gate, and then discharging it by double pumping (fine and coarse). Pulses classified by height and width cause the discharge through fast transistors; a synchronization system is needed to guard against errors. Tunnel-diode discriminators control the opening and closing of the pumping gates through tunnel-diode trigger circuits. Two per cent linearity is obtained with input pulses between 0.3 and 6 v and with a duration greater than or equal to 20 nsec, or else with pulses going up to 8 v but with a duration greater than or equal to 28 nsec. (auth)

24036 APPLICATION OF THE SAMPLED PARAMETER METHOD TO THE DESIGN AND CONSTRUCTION OF WIDE-BAND TRANSISTORIZED AMPLIFIERS. J. G. Linvill (Univ. of Stanford, Calif.) and G. Danon. p. 829-39 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

Experiments in nuclear physics laboratories often call for specially designed fast pulse amplifiers. The latest transistors can with advantage be used in place of valves in this field. The application of J. G. Linwill's sampled parameter method to the design of such amplifiers is discussed. This calculation enabled a repeater stage to be constructed to the following specifications: characteristic impedance of 50 ohms; gain of 10 db; transmission band of 400 MHz; rise time of 1 nsec; rebound of less than 10 per cent; noise factors of between 8 and 10 db; maximum output level for negative pulses of 500 mv, and for positive pulses of 200 mv. Three stages in cascade supply 30 db, with a rise time of 1 nsec and a transmission band of 400 MHz. (auth)

24037 IMPROVEMENTS IN OR RELATING TO GEIGER-MÜLLER TUBES. Michael James Butler (to Mullard Ltd.). British Patent 956,120. Apr. 22, 1964. Filed Feb. 8, 1963.

A halogen-quenched Geiger-Mueller tube for measuring the β-ray emission of liquids is patented. The tube has a high β sensitivity with low cosmic- and γ-ray background. The tube contains 2 cylindrical coaxial electrodes. The outer electrode, or cathode, is surrounded by a hollow cylindrical envelope forming an annular space for a liquid sample. The inner electrode, or anode, is closed at one end forming a second space for a liquid sample. The annular space between the anode and the cathode is the discharge space and is filled with a mixture of rare gases and a small amount of a halogen gas. The liquid samples are electrically insulated from each other. The preferred material for the electrodes is chrome iron. (M.P.G.)

24038 NUCLEAR FISSION CHAMBER AND METHOD FOR ITS CONSTRUCTION. (Brown Boveri/Krupp Reaktorbau GmbH). British Patent 956,238. Apr. 22, 1964. Priority date Apr. 10, 1962, Germany.

A spiral-fission-chamber-type neutron detector and a process for the preparation of the spiral coils coated with fissile material are patented. The spiral coils are made of foil strips coated with Th-232. The edges of the foil are covered with an elastic insulating material to provide insulation and spacing when the foil is coiled. The foil is coated by dipping it into a mixture of a Th compound and a binder containing combustible organic compounds. The foil is then passed through an oven, in which the organic compounds in the binder are burned off and the Th compound is converted to Th oxide. A mechanical stripper removes defective parts of the coating after the foil leaves the oven, and the process is repeated until a coating of the desired uniform thickness is obtained. A recommended dipping mixture is Th nitrate, alcohol—acetone, and varnish, with a Th-232 content of 1 to 10 wt %. (M.P.G.)

24039 IMPROVEMENTS IN OR RELATING TO NEUTRON FLUX PLOTTING SYSTEMS. Alan Lyle Gray and Arnold Metcalf (to Plessy Co. Ltd.). British Patent 956,555. Apr. 29, 1964. Filed June 19, 1959.

A small ionization-type neutron detector suitable for use in reactor cores is patented. The detection consists of an ionization chamber with coaxial tubular electrodes. The surface of the anode is coated with a neutron-sensitive material, and the outer surface of the cathode surrounding the anode has a shielding coating of neutron-sensitive material. The ends of the cathode are closed with plates, which also have a shielding coating. The anode coating may include U-235 or B-10. If U-235 is used, suitable shielding coatings would include Rh, In, Au, or oxides of Lu or Er. A shielding coating of Li, Cd, or Dy may be used with an anode coating of B-10. (M.P.G.)

24040 MONITOR FOR RADIOACTIVE RAYS. Josef Schreiner (to EMAG Elektrizitats GmbH). German Patent 1,161,649. Jan. 23, 1964. Priority date Oct. 19, 1960.

A monitor which comprises a Geiger-Müller counter and an audible indicating device for the indication of a predetermined dosage rate is described. The counter pulses which are integrated by an RC-network in a known manner are used to switch on a monostable multivibrator via a glow lamp which switches the acoustic signal circuit. A notable feature of the invention is that for controlling the multivibrator only small pulses of short duration are necessary so that the condenser of the integrating network can be very small. This results in a high sensitivity and a small size of the monitors. (Gmelin Inst.)

24041 METHOD AND DEVICE FOR CONTINUOUS MEASUREMENT OF RADIOACTIVITY OF SUBSTANCES CONTAINED IN A LIQUID. Peter Schranz (to Landis and Gyr. AG). U. S. Patent 3,134,018. May 19, 1964. Priority date Dec. 3, 1958, Switzerland.

A simple arrangement is described for measuring with previously unattainable accuracy the radioactivity of substances contained in a liquid. The liquid is fed in a uniform stream to a strip of absorbent material in uniform motion. The liquid is evaporated by heating, and the radioactivity of the substances deposited on the strip is measured. (D.C.W.)

ISOTOPE TECHNOLOGY

General

24042 (AERE-R-4555) A METHOD FOR THE STANDARDIZATION OF ZIRCONIUM 95-NIOBIUM 95. J. E. Hiscott and R. A. Allen (United Kingdom Atomic Energy Authority. Research Group. Wantage Research Lab., Wantage, Berks, England). Feb. 1964. 14p.

The standardization of "parent-daughter" nuclide mixtures is discussed with principal reference to ^{95}Zr-^{95}Nb. A method of measuring the activity of this mixture by an adaptation of the 4π β-γ coincidence counting technique is described. The necessary approximations in the method are evaluated. (auth)

24043 (INS-R-14) THE ADDITION OF RADIOACTIVE TRACER AND ITS MEASUREMENT. Titahi Bay Sewer Outfall Investigation. W. J. McCabe and H. S. Jansen (New Zealand. Inst. of Nuclear Sciences, Lower Hutt). May 1962. 14p.

Procedures are described for studies of sewage dilution and flow studies using ^{32}P as a tracer. The tracer was added to the sewage at a point just before the pump house, and samples were taken at various locations before discharge into the sea and counted with a liquid dip counter. A typical case is described after the addition of 5 C of activity to 6×10^5 l of sewage of 5 hr and discharged into the Titahi Bay. (C.H.)

24044 (NP-13931) BIBLIOGRAPHY ON RADIOISOTOPE APPLICATIONS IN HYDROLOGY AND SOIL MOISTURE MEASUREMENTS. (Union of South Africa. Atomic Energy Board, Pretoria). [1962]. 3p.

A list is presented of 51 references to literature on applications of radioisotopes in hydrology and soil moisture measurements. (C.H.)

24045 EVALUATION OF A RADIOACTIVE TRACER METHOD FOR MEASURING WATER INTAKE OF SOILS. B. D. Meek, A. J. MacKenzie, and K. R. Stockinger (Southwestern Irrigation Field Station, Brawley, Calif.). Soil Sci. Soc. Am. Proc., 28: 153-5(Mar.-Apr. 1964).

A tracer method of measuring water intake by application of radioactive Au in the irrigation water was evaluated. When irrigation water containing a constant known amount of isotope is applied to the soil, the amount of isotope adsorbed is proportional to the amount of water entering the soil. To calculate water intake, the amount of isotope adsorbed is determined by measuring the activity of soil samples taken in the field. Two factors, vertical distribution of the tracer in the soil, and magnitude of adsorption on the soil surface from flowing irrigation water, were studied. The radioactive tracer was not measurably lost by adsorption from the tagged water as it flowed over the soil surface. It was adsorbed near the soil surface and sampling to a depth of 6 cm recovered 95% of the Au in Holtville clay loam. The method was used to determine water intake variability. Samples within a plot had an average coefficient of variability of 9%. This would require 7 samples to determine the mean water intake within 10% at the 1% level. (auth)

Industrial Applications

24046 (PAN-485/I-A) A FAST AND CONVENIENT METHOD OF MEASURING THE THICKNESS OF THIN COATINGS ON STEEL SHEETS. Adam Jasiński, Jan Kownacki, and Henryk Lancman (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Dec. 1962. 9p.

A method of measuring coating thicknesses is proposed in which the x-ray fluorescence excited in the coating is used. Measurements were made using various thicknesses of tin coatings on steel sheet. The scintillation technique was applied. A calibration curve for the range of thicknesses up to 13 μ is given. The use of this method as a basis for constructing a gage is described. (auth)

24047 RADIOACTIVE WEIGHING SYSTEM FOR MOVING VEHICLES. James J. Wright (to Cleveland Technical Center, Inc.). U. S. Patent 3,132,247. May 5, 1964. Filed Nov. 2, 1959.

A system for measuring the weight of moving railway vehicles is proposed. The system consists of ^{60}Co gamma sources arranged beneath the track and a system of radiation detectors arranged overhead. (C.E.S.)

24048 METHOD AND APPARATUS USING RADIATION TRANSDUCERS. Robert Earl Black (to General Motors Corp.). British Patent 956,112. Apr. 22, 1964. Priority date, Dec. 11, 1961, United States.

A method and apparatus for measuring physical characteristics, such as gas pressure, density, liquid level, etc., using radiation transducers is patented. The invention may be used to measure any characteristic or condition that can cause mechanical motion between 2 parts. A target is bombarded with β rays to produce x rays. The β rays are attenuated as a function of the characteristic to be measured, and the x rays produced by the attenuated β rays are measured. The β rays may be attenuated by a shield, which moves as a function of temperature, liquid level, or pressure. Gas density may be measured by using the gas as the attenuator. The recommended β source is Sr-90, recommended target materials are W, U, Pb, or Au, and the shield may be made of Al, Be, C, or Si. (M.P.G.)

Power Application

Refer also to abstract 24358.

24049 RADIOACTIVE HEAT SOURCE AND CONTAINER WITH HELIUM PERMEABLE WINDOW IN THE CONTAINER. Robert S. Rochlin (to General Electric Co.). U. S. Patent 3,133,196. May 12, 1964. Filed Oct. 29, 1959.

A nuclear battery is designed which utilizes an alpha particle-emitting radioisotope as a heat source and which has means for relieving the helium pressure in the battery container. The means comprises a window which is permeable to helium gas but impervious to other gases of higher atomic number and size. Thus, radioactive gases such as radon and thoron do not permeate through the window. Glass compositions which may be used in the window are given. (D.L.C.)

Separation and Production

Refer also to abstract 24929.

24050 (ORNL-3607) REVIEW OF ORNL THERMAL DIFFUSION PROGRAM, JANUARY-DECEMBER 1963. T. A. Butler, W. R. Rathkamp, and H. B. Greene (Oak

Ridge National Lab., Ill.). May 1964. Contract W-7405-eng-26. 18p.

A review is presented of activities, equipment used, theoretical studies, and production data. (auth)

24051 (JPRS-24590) THE PRODUCTION OF ^{32}P FROM P_2O_5 IRRADIATED WITH NEUTRONS. Olga Jovanovic-Kovacevic and Radmila Nestorovic. Translated from Tehnika (Belgrade), 19: 623-5(1964). 7p. (OTS-64-31254)

The procedure, equipment, and cell for the production of 1000 Mc of ^{32}P through the irradiation of P_2O_5 with neutrons are described. The characteristics of the products obtained are listed. Chemical analysis and radiometric measurements proved that the quality of the ^{32}P obtained is at the requisite level. (auth)

24052 (ORNL-tr-68) ISOTOPIC EXCHANGE BETWEEN CARBON DIOXIDE AND ITS ETHANOLAMINE SOLUTIONS. I. A. Semiokhin, G. M. Panchenkov, K. M. Salimova, and Yu. P. Andreev. Translated by A. L. Monks (Oak Ridge National Lab., Tenn.), from Vestn. Mosk. Univ., Ser. II: Khim., No. 1, 35-8(1964). 5p.

The single separation coefficients for carbon and oxygen isotopes in the exchange between carbon dioxide and its ethanolamine solutions were determined and their dependence on the concentrations of mono-, di-, and triethanolamine solutions were investigated. Calculations were made according to an equation derived for multistage experiments. Results are presented in tables. (M.C.G.)

24053 (ORNL-tr-69) USE OF AQUEOUS-ACETONE POTASSIUM BICARBONATE SOLUTIONS TO SEPARATE CARBON ISOTOPES. PART II. I. A. Semiokhin, L. K. Lykova, and A. G. Serenkova. Translated by A. L. Monks (Oak Ridge National Lab., Tenn.), from Vestn. Mosk. Univ., No. 5, 29-31(1963). 4p.

The effect on the carbon isotope separation coefficient of the solution flow rate into the column was investigated. The single separation coefficient was determined, using a multistage experiment. Aqueous-acetone sodium bicarbonate solutions were used. It was found that separation decreased when the flow rate was increased. This was due to the fact that the carbon isotopic exchange takes place slowly in the column where the reaction occurs only in the polymolecular film. The single separation coefficient for CO_2-KHCO_3 systems was 1.008 in both experiments. (M.C.G.)

24054 (ORNL-tr-134) ECONOMIC ASPECTS OF THE ENRICHMENT OF URANIUM BY GASEOUS DIFFUSION. J. Gaussens, R. Jacques, and J. C. Martin (France. Commissariat a l'Energie Atomique, Paris). Translated by S. Blumkin (Oak Ridge Gaseous Diffusion Plant, Tenn.), from a Paper from the SEAA Colloquium on Fuel Cycles, Baden-Baden, Germany. 34p.

Some formulas to price enriched or depleted uranium were established as a function of economic (basic costs) and technical parameters (product and reject concentrations, separative work). A graphical method, resolving all the problems of determining the price, is presented. This method was applied to several problems such as plant optimization, acquisition of product by blending, and determination of a price scale for enriched or depleted uranium. Results from the established scale are: the immediate neighborhood of the natural abundance is a particular region where the size of the cascade matters little; the establishment of price scales for depleted uranium is delicate and depends first on production policies imposed on the cascade; the price of enriched uranium decreases very strongly if the size of the cascade increases; and the price of enriched uranium is very sensitive to the design of the cascade. It was concluded that it is important to study the structure of the demand before constructing a diffusion cascade so as to conceive a cascade adapted as precisely as possible to this demand. The losses that can be expected from a poor adaptation can be much larger than the gains that can be realized from minimizing the cost of electrical power (choice of site) or of normal UF_6 (choice of supplies of U_3O_8). (auth)

24055 SEPARATION OF BORON ISOTOPES USING ANION EXCHANGE RESINS. Robert Rosset (CEA, Fontenay-aux-Roses, France). Bull. Soc. Chim., France, No. 3, 607-16(Mar. 1964). (In French)

The boron isotopes were separated using the equilibrium exchange reaction between boric acid in aqueous solution and the borate and polyborate ions in some anion exchange resins of the quaternary ammonium type (Dowex 1 and 2). The effects of boric acid concentration and of the presence of glycerol on the process was studied. Exchange constants were determined by frontal analysis. An interpretation of the observations is given. (D.C.W.)

24056 THE PREPARATION OF RADIOACTIVE SOURCES FOR β SPECTROSCOPY BY THE ELECTROLYTIC DEPOSITION OF RARE EARTHS. A. F. Novgorodov, V. L. Kochetkov, N. A. Lebedev, and V. A. Khalkin. Radiokhimiya, 6: 73-8(1964). (In Russian)

Rare earths obtained by bombarding a Ta target with 660-Mev protons were separated chromatographically with the use of 0.8M ammonium lactate as an eluant. For magnetic β spectroscopy, it is desirable to obtain a thin layer of radioactive material on a metallic backing as a source. According to the literature, the simplest and most convenient way of preparing a thin homogeneous source is by electrolytic deposition at a pH of 1.5 to 4.0. Electrolysis leads to the formation of a tightly-adherent rare earth hydroxide film on the cathode. A microelectrolytic cell is described in which the rare earth samples can be evaporated 2 or 3 times on the anode to 0.01 to 0.02 ml (half a drop). This operation decreases the concentration of ammonium lactate from 0.8 to 0.05M. Optimum deposition was obtained at a current strength of 10 mamps and a time of 20 minutes. The rare earth hydroxide could be deposited on Al, Cu, Ni, Ti, or Pt, but the yield on an Al backing was only 65 to 70%. All the operations can be carried out by remote control so that work can be performed with high levels of radioactivity. A significant increase in the resolution of the conversion electrons from ^{169}Yb and ^{153}Dy was obtained on using an electrically deposited source as compared to a source prepared by direct drying. (TTT)

24057 ^{13}C ENRICHMENT BY CS_2-XANTHOGENATE EXCHANGE. K. Wetzel, G. Kretzschmann, and R. Kiessling. East German Patent 25,135. Apr. 16, 1963.

24058 METHOD OF PREPARING DEUTERIUM-ENRICHED HYDROGEN. Bernard Lefrancois, Henri Sack, Christian Vaniscotte, and Gregoire Dirian (to Houilleres du Bassin du Nord et du Pas-de-Calais and Commissariat a l'Energie Atomique). U. S. Patent 3,133,793. May 19, 1964. Priority date Dec. 13, 1958, France.

A method is described for preparing deuterium-enriched hydrogen at temperatures from −70 to +70°C, using Cs or Rb amides or such amides dissolved in liquid ammonia to catalyze the reactions. The use of the Cs and Rb amide catalysts eliminates the handling hazards and solubility problems associated with the alkali amides previously proposed as catalysts, while increasing the reaction rate. (D.C.W.)

MATHEMATICS AND COMPUTERS

Refer also to abstracts 23195 and 23818.

24059 (KAPL-M-6144) GRAPH—A SUBROUTINE TO DRAW CURVES WITH THE PHILCO-2000. W. B. Jordan (Knolls Atomic Power Lab., Schenectady, N. Y.). Mar. 26, 1964. Contract W-31-109-eng-52. 9p.

The GRAPH digital computer subroutine plots curves of data computed in a Philco-2000 program. The curves are printed by the off-line printer along with other output from the program. There can be several pages of curves, with several curves on each page. Scales are printed for each curve. Output is described, and sample output is included. (auth)

24060 (KAPL-M-6148) CRAMP—A MATRIX MANIPULATION PROGRAM WITH RECYCLING OPERATIONS. R. W. Guillette and G. P. Calame (Knolls Atomic Power Lab., Schenectady, N. Y.). Apr. 13, 1964. Contract W-31-109-eng-52. 46p.

The CRAMP program performs manipulations and operations on matrices with a maximum dimension of 54. The program has the ability to use magnetic tapes as auxiliary storage and to recycle through a set of previously specified operations. The operations and instructions are discussed, and sample problems are included. Application to the computation of diffusion lengths is also outlined. The program is in FORTRAN for the IBM 704. (D.C.W.)

24061 (TDSI-49) DEEMS—A FORTRAN PROGRAM FOR SOLVING THE FIRST DEGREE COUPLED DIFFERENTIAL EQUATIONS BY EXPANSION IN MATRIX SERIES. L. Pease (Atomic Energy of Canada Ltd. Power Projects, Toronto). Oct. 1963. 39p. (AECL-1898)

The DEEMS program obtains the solution of linear, first degree, coupled differential equations up to order 12. The method used is essentially different from finite difference methods; it does not depend upon being able to transform the coefficient matrix to diagonal form, nor does it require that the coefficient matrix be nonsingular. It is assumed that the coefficient matrix is real, though this is not essential to the method. (auth)

24062 ON WEAKLY POSITIVE MATRICES. Eugene P. Wigner. Can. J. Math., 15: 313-17(1963).

A matrix is termed weakly positive if all of its characteristic values are positive and the characteristic vectors form a complete set. Two theorems for the relation and products of weakly positive and positive definite matrices are proved, and the theorems are extended in a third theorem to bounded linear operators in Hilbert space. (D.C.W.)

24063 DESCRIPTION OF A MULTIPARAMETRIC SYSTEM WITH INTEGRAL COMPUTER. F.-L. Sicard. p.497-503 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

A digest is given of the requirements of multiparametric analysis from the view-point of the number of classes and the number of events in several types of experiment. The concepts of physical time, real time, and delayed time are then discussed in the context of nuclear physics and digital computers. Problems of the link between operator and electronic system are touched upon. The functional diagrams of three principal solutions are considered: MPA system with standard units with associated computer, MPA system with a real time computer, and MPA system with standard units and integral computer. A combination of these solutions is then discussed; this allows a universal digital computer to be connected to various different points on the system and it is possible to gather more nonmultiparametric data, which are essential for analysis of the experiment. It is shown that it is possible to add peripheral equipment controlling to the experiment itself. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General

24064 (BNL-855) HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW. A Bimonthly Technical Progress Review. Volume 2, No. 1 (Brookhaven National Lab., Upton, N. Y.). Feb. 1964. Contract AT-30-2-GEN-16. 50p.

Reviews are presented of 30 papers on fluid dynamics, heat transfer, material development and corrosion, instrumentation, component development, system studies, chemical analysis and chemistry, fabrication techniques, and physical and thermal properties. (N.W.R.)

24065 (GEMP-34A) HIGH-TEMPERATURE MATERIALS PROGRAM. Progress Report No. 34, Part A. (General Electric Co. Advanced Technology Services, Cincinnati). Apr. 15, 1964. Contract AT(40-1)-2847. 41p.

Volume expansion in the beryllium oxide specimens of different grain sizes ranged from 0.5 to 1.0% for exposure at 650°C under fluxes of 4 to 6×10^{13} nv and dosage of approximately 2.5×10^{20} nvt (≥1 Mev). Expansion of EBOR material compared favorably with that of nonglass compositions of similar grain size, and there was no change in the modulus of rupture strength. Further measurements were completed on the helium content, helium bubbles, and defect clusters in irradiated samples. In thermal annealing of a specimen irradiated to $\sim 10^{21}$ nvt (≥1 Mev) at 900°C, both annealing of the radiation-induced expansion and further growth of the specimen were observed. The growth was due to helium collecting into bubbles of approximately 2 micron size. The ion gun assembly was completed, and the lattice orientations with respect to the plane crystal surfaces were determined for 7 monocrystalline targets of sapphire. Arc-cast tantalum cathodes of wire, sheet, and hollow cylinders, which were resistively heated, plasma heated, or cold, were used to analyze the effects of applied voltage, tube current, cathode temperature, cathode pressure, and cathode-anode separation distance when krypton is introduced into the tantalum cathodes under glow discharge. The results indicate that the inert gases can dissolve and diffuse in hot, hollow cathodes which are plasma-heated under glow discharge as well as under arc discharge. Binary UO_2-ThO_2 and $UO_2-Y_2O_3$ fuel compositions of mechanically mixed oxides were reacted in air to 1850°C for 1 hour to form single-phase face-centered cubic structures; however, various reaction methods used on ternary $UO_2-ThO_2-Y_2O_3$ fuel compositions generally resulted in incompletely crystallized structures. Compositions having Y_2O_3-to-UO_2 mole ratios less than 0.55 were particularly susceptible to fuel loss and composition change when reacted for long periods of time at 1650°C in air. BeO fuel elements fueled with UO_2-ThO_2 and $UO_2-ThO_2-Y_2O_3$ compositions were sintered to 98 to 99% of theoretical density with small grain sizes and high strengths. A fuel retention test on these fuel elements at 1400°C in air has shown no fuel loss in 170 to 300 hours. BeO specimens fueled with high ThO_2 content fuels have shown essentially no UO_2 loss or grain growth in 1000 hours at 1300°C in air. UO_3 partial pressure measurements of UO_2-ThO_2, $UO_2-Y_2O_3$, and $UO_2-ThO_2-Y_2O_3$ fuel compositions show that the UO_3 pressure decreases as the ThO_2 content in the composition increases and the pressures of fuel compositions containing 0.55 mole of Y_2O_3 per mole UO_2 are lower by an average factor of 3 to 6 than the same binary fuels without Y_2O_3. When the oxygen sublattice of fluorite type structures is filled, the partial pressures of UO_3 over solid solutions of $UO_{2.00}-ThO_2$ can be predicted by Raoult's law. The pressure of UO_3 over solid solutions of $UO_{2+x}-Y_2O_3$ can be predicted by using a regular solution model with an interaction energy of 41 kcal/g formula weight of uranium. (auth)

24066 (NMI-2126) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report to United States Atomic Energy Commission for the Month of February 1964. (Nuclear Metals. Div. of Textron Inc., West Concord, Mass.). Apr. 10, 1964. Contract AT(30-1)-2784. 58p.

The fabrication of tungsten and rhenium–tungsten alloys by drawing and extrusion is described. Metallographic and ring compression data are obtained on the drawn tubing and on its response to anneals. The preparation and properties of zone-refined beryllium crystals are studied with respect to the effects of aluminum, iron, nickel, and silicon additions. Splatcooled U–0.8 wt % Be and U–0.6 wt % Al–1.0 wt % Si alloys are produced and tested for hardness. The splatcooled and cast U–Be–C alloy and the splatcooled U–Al–Si alloy are extruded into shapes suitable for mechanical testing. (N.W.R.)

24067 (NMI-2127) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report, March 1964. (Nuclear Metals, Inc., West Concord, Mass.). May 13, 1964. Contract AT(30-1)-2784. 58p.

The fabrication of tungsten and rhenium–tungsten alloys by drawing and extrusion is described. Metallographic and ring compression data are obtained on the drawn tubing and on its response to anneals. The preparation and properties of zone-refined beryllium crystals are studied with respect to the effects of iron and nickel additions. The U–0.2 wt % Be, U–Be–C, and U–Al–Si SLIS alloy systems are evaluated. The Zr–1.14 wt % Be alloy is splatcooled. (N.W.R.)

24068 (NP-13955) DESIGN DATA STUDY FOR COATED COLUMBIUM ALLOYS. Final Summary Technical Report, March 1, 1963 through March 1, 1964. (Thompson Ramo Wooldridge Inc. TRW Electromechanical Div., Cleveland). Apr. 1, 1964. Contract NOw 63-0471c. 210p. (ER-5885)

Design data properties were determined for four protective coating Nb alloy systems involving Pfaudler and TRW oxidation protective coatings on B-66 and D-43 Nb alloys up to 2600°F. Prior to the design data study, preliminary oxidation (low pressure and one atmosphere), bend and tensile tests were conducted on B-66 and D-43 using two different Pfaudler coatings and the TRW Cr–Ti–Si coating. Based on these evaluation tests the Pfaudler single-cycle silicide coating and the TRW coating were selected for the mechanical properties evaluation. The following design properties were determined for the four coating-base metal systems: cyclic oxidation protective life; tensile properties of uncoated sheet in vacuum and coated sheet in air; creep properties of coated sheet in air; and coating deformation tolerance. In addition, a limited evaluation of the ballistic impact resistance of the coatings at room temperature, and the tensile properties of coated joints was conducted. (auth)

24069 (NP-13957) O DVIZHENII POR V TVERDOMTELE, VYZVANNOM TERMICHESKOI MIGRATSIEI ATOMOV PO IKH POVERKHNOSTI. (Movement of Pores in a Solid Body Due to Thermal Migration of Atoms Along Their Surface). E. Ya. Mikhlin (U.S.S.R. Sovet Ministrov. Gosuderstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1963. 15p.

Thermal migration of atoms along the surface and induced pore movement in solids are investigated. The rate of pore shift and atomic flux density on the surface are determined as functions of temperature gradient. The rate of pore shift is inversely proportional to pore radius. (R.V.J.)

24070 (RTD-TDR-63-4089) VACUUM-ARC MELTING OF EXPERIMENTAL REFRACTORY METALS. S. Inouye (Research and Technology Div. Air Force Materials Lab., Wright-Patterson AFB, Ohio). Oct. 1963. 22p. (AD-426688)

Vacuum arc melting of experimental refractory metals is summarized. The influence of furnace design modifications and melt variables on electrode melt rates is shown. Minor additions of oxygen and titanium to tungsten electrodes reduce the melt rate and additions of carbon and zirconium cause no significant change in melt rate. Increased melting current also increases electrode consumption rate. In general, coarser macrostructures are associated with slower melt rates. (auth)

24071 (WADD-TR-61-72(Vol.XII)) RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XII. DEVELOPMENT OF AN IMPROVED LARGE-DIAMETER FINE-GRAIN GRAPHITE FOR AEROSPACE APPLICATIONS. C. W. Waters and E. L. Piper (National Carbon Co. Advanced Materials Lab., Lawrenceburg, Tenn.). May 1963. Contract AF33(616)-6915.

A method for producing graphite using a pressure curing process is described. The process is based on a thermosetting binder system and is employed to develop a reasonably uniform fine-grain graphite. Investigations were made of the process variables in an attempt to reach optimum properties and to scale up to 30-in. diameter sizes. This graphite, designated "Grade RVA," is nominally characterized by a bulk density of 1.85 g/cm^3, room-temperature with and against grain flexural strengths of 3700 and 2900 lbs/in.^{2} respectively, with and against grain elastic moduli of 1.7 and 1.3 million lbs/in.^{2} respectively, and variations in these properties of only one-half to one-third of those normally associated with quality industrial graphites such as grade ATJ. Future activities to further improve quality are also indicated. (auth)

24072 (EURAEC-934) STUDY OF THE SHAPING AND THE IRRADIATION OF URANIUM MONOCARBIDE. Quarterly Progress Report No. 12, October 1–December 31, 1963. J. P. Dumas and B. Mansard (France. Commissariat a l'Energie Atomique, Paris). Work Performed under United States–Euratom Joint Research and Development Program. Contract 080-62-3 RDF. 41p. (A translation)

Uranium carbide pellets obtained by sintering reaction under load and irradiated for 3082 hours in Mélusine, up to a combustion rate of 437 MWd/t, are studied. Tests carried out outside the reactor on the irradiation device designed for EL.3 led to changes in the safety arrangements. The zirconium carbide prepared by sintering reaction under load, which must be used as heat lagging in the high-temperature irradiation assemblies, is studied. After calibration of the dilatometer, we have measured an average expansion coefficient of 8.5×10^{-6} between 20 and 1000°C. Compatibility tests between UC–ZrC and ZrC–stainless steel conducted during 1000 hours at 750°C under secondary vacuum, with a load of 100 k/cm^2, show that there is no sticking between these materials. By making use of the extraction experiments of fission gas, we were able to determine an activation energy of ^{133}Xe release of 55 kcal/mole, in the case of uranium carbide monocrystals containing 5.1% of carbon. (auth)

24073 GRAPHITE AS A BARRIER TO FISSION PRODUCTS IN HIGH-TEMPERATURE REACTORS. John Bromley (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Brit. Nucl. Energy Soc., 3: 99-105(Apr. 1964).

The development of suitable forms of graphite, both as low permeability tubes for containing bulk carbide fuels and as thin coatings of pyrographite on the individual fuel particles for containment of fission products, is traced. Work carried out on the migration of gaseous and solid fission products in fuel elements is reviewed. In particular, the mechanism by which the coating on fuel particles can deteriorate under irradiation and the ways by which fission products can escape through fuel tubes are considered. (L.B.S.)

24074 THE EPITAXIAL GROWTH OF SILVER AND GOLD FILMS BY SPUTTERING. D. S. Campbell and D. J. Stirland (The Plessey Co. Ltd., Towcester, Northants, Eng.). Phil. Mag. (8), 9: 703-7(Apr. 1964).

Epitaxial gold and silver films were sputtered onto rocksalt substrates at room temperature. The temperature is lower than the epitaxial temperature quoted for evaporated films. These results may be due to enhanced mobility of the sputtered films or to ionic cleaning of the surfaces by the discharge. (M.J.T.)

24075 PLENUM PRESS HANDBOOKS OF HIGH-TEMPERATURE MATERIALS. NO. 1. MATERIALS INDEX. Peter T. B. Shaffer. New York, Plenum Press, 1964. 757p. $17.50.

Information is included on the general properties, chemical, electrical, mechanical, nuclear, optical, structural, and thermal properties of borides, carbides, mixed carbides, elements, nitrides, oxides, mixed oxides, and silicides. 698 references arranged in numerical and alphabetical form (by author) and units and conversion factors are appended. (P.C.H.)

24076 TSIRKONII I GAFNII (TEKHNICO-EKONOMICHESKOE OBOBSHCHENIE I ANALIZ MINERAL'NO-SYR'EVYKH RESURSOV, PROIZVODSTVA I PRIMENENIYA). (Zirconium and Hafnium (Technical and Economical Analysis of Mineral Resources, Their Preparation and Applications). S. Ya. Kaganovich. Moscow, Publishing House of the Academy of Sciences, 1962. 182p.

A review is given on the economic and technological future of Hf, Zr, and their alloys. Mineral resources, mining, technology, and industrial applications are discussed. 351 references. (R.V.J.)

24077 ZIRCONIUM ALLOYS. Lester Rubenstein and Francis Shubert (to Westinghouse Electric Corp.). German Patent 1,161,694. Jan. 23, 1964. Priority date Sept. 6, 1960, United States.

Highly corrosion resistant zirconium alloys are described that have a good workability. These alloys are composed of 0.1 to 2.5% tin, 0.015 to 0.30% silicon, at least 0.10% but not more than 2% of at least one of the metals of iron, nickel, and chromium, not more than

0.05% carbon, and the rest zirconium with less than 0.5% of impurities. (Gmelin Inst.)

24078 ELECTROLYTE AND METHOD FOR THE PREPARATION OF BERYLLIUM BY FUSION ELECTROLYSIS OF ORGANIC BERYLLIUM COMPOUNDS. German Patent 1,162,576. Feb. 6, 1964. Filed Nov. 7, 1959.

The electrolyte given is a homogeneous melt of organic beryllium complex compounds of the general formula $(MeF)_m \cdot (BeRR')_n$ (Me are alkaline metals, R and R′ are saturated aliphatic or aromatic rests with the exception that R′ may be a hydrogen atom, and m and n are numbers the ratio m : n being 1 : 1 or 2 : 2). The method described is for the electrolytic separation of pure beryllium from the said electrolyte, and it is carried out in the temperature range from 65 to 95°C using a disintegration voltage of 1 v and a current density of 0.2 amp/cm^2. (Gmelin Inst.)

24079 NEUTRON SHIELDS AND METHODS OF MANUFACTURING THEM. Richard A. Alliegro and Torstan W. Ekberg (to Norton Co.). U. S. Patent 3,133,887. May 19, 1964. Filed Oct. 6, 1958.

A technique is described for producing light-weight, readily-machined neutron shields of various shapes and desired properties. Essentially, granular boron carbide is mixed with epoxy resins (bisphenol A and F monomers), and a hardener is added. For lightness, a large proportion of volatile solid is included. An extender is used to make the mix more workable and to induce green shrinkage. The mix is then put into the mold, pressurized, and cured. Shield properties are controlled by controlling composition and particle size. (D.C.W.)

Corrosion

24080 (BMI-X-286) CORROSION OF NIOBIUM-BASE ALLOYS IN STEAM AT 540°C AND 650°C. Warren E. Berry and John A. DeMastry (Battelle Memorial Inst., Columbus, Ohio). [1963]. Contract W-7405-eng-92. 16p. (CONF-509-2)

From 13th Annual Corrosion Symposium, Argonne, Ill., May 1964.

Studies of the corrosion of niobium alloys in steam at 540 and 650°C resulted in the development of several alloys that show promise as cladding materials for nuclear superheat applications. The most promising alloys contain 21Ti–12V–9Cr and 24Ti–12V–12Cr. They possess the following properties: general oxidation resistance approaching that of austenitic stainless steels; thermal neutron absorption cross section lower than or comparable to, austenitic stainless steels; no major alloying addition that would produce long-lived radioisotopes in corrosion products; much better high-temperature strength than austenitic stainless steels; and perhaps, better resistance to chloride stress-corrosion cracking than austenitic stainless steels. (auth)

24081 (CONF-509-1) SOME OBSERVATIONS ON ZIRCALOY-2 HYDROGEN UPTAKE CHARACTERISTICS. A. E. Bibb, A. P. Beard, and E. J. Callahan (Knolls Atomic Power Lab., Schenectady, N. Y.). [1962]. Contract W-31-109-eng-52. 53p.

From 13th Annual Corrosion Symposium, Argonne, Ill., May 1964.

Data obtained from two Zircaloy-2 corrosion programs undertaken to determine the effect of stress-relief annealing on the subsequent corrosion resistance of preoxidized wrought Zircaloy-2, and the effect of oxygen and nitrogen on the corrosion characteristics of consolidated Zircaloy-2 powder are discussed. The corrosion characteristics in 680°F water and 750°F steam are briefly reviewed, however, the major emphasis is placed on the extensive hydrogen uptake data generated in these studies; its interpretation, its relation to other data reported in the literature, and its implications. (auth)

24082 (HW-79811) OXIDE TENACITY ON ALLOYS EXPOSED TO REACTOR COOLANTS. L. D. Perrigo (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 1963. Contract AT(45-1)-1350. 20p.

Several tests to determine film tenacity and release of retained film radioactivity were made on various alloys that were exposed to either neutral or high pH in-reactor loop water. Tenacity and film release characteristics were determined by changes in surface radioactivity levels of specimens that were contaminated but not irradiated. From tests with carbon steel and stainless steel exposed in a high pH water it was found that the total amount of radioactivity available for release was appreciably greater on carbon steel than on stainless steel. The same trend was true for both loosely adherent matter and material released by severe thermal shock. One test with Zircaloy-2 revealed that it had much more loosely adherent material and suffered greater thermal shock losses than the two steels. Its losses were about twice those of carbon steel, resulting in a surface radioactivity loss of 68%. Of the five materials, carbon steel, Zircaloy-2, AISI 304 stainless steel, and two aluminum alloys that were exposed to neutral pH water, film tenacity tests showed that the amount of radioactive film available for release to the coolant varied as follows: X-8001 aluminum alloy = A-288 aluminum alloy = carbon steel > Zircaloy-2 > AISI 304 stainless steel. The information obtained from these studies indicated that loop systems composed of stainless steel operating with high-temperature neutral of high pH water would be less prone to crud burst problems and unexpected radioactivity releases than systems containing components of aluminum, Zircaloy-2, or carbon steel. Carbon steel was a more acceptable alloy, so far as film tenacity was concerned, in high pH water than in neutral water. Zircaloy-2 total radioactivity losses were comparable in both types of water, but thermal shock susceptibility was far greater in high pH water. Because of corrosion limitations, aluminum would be used only in neutral or low pH systems. (auth)

24083 (HW-81196) BEHAVIOR OF CHEMICAL NICKEL PLATE ON ALUMINUM ALLOYS IN HIGH TEMPERATURE, DYNAMIC, AQUEOUS SYSTEMS. A. B. Johnson, Jr. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1964. Contract AT (45-1)-1350. 37p.

Behavior of chemically-deposited (electroless) nickel on 1245 and 8001 aluminum alloys was investigated in high flow (25 ft/sec) and low flow aqueous systems at 300 and 330°C. Effects of heat treatment on corrosion properties of the nickel plate were studied. Relatively thick nickel/aluminum diffusion layers suppressed catastrophic failure of 1245 aluminum at 330°C. Magnetic and crystalline properties of the nickel plate are discussed; behavior of exposed aluminum at defects in the nickel plate is reported. (auth)

24084 (MSAR-64-51) EFFECT OF HIGH-TEMPERATURE SODIUM ON AUSTENITIC AND FERRITIC STEELS. PHYSICAL PROPERTIES OF MATERIALS. Progress Report No. 44, April 1964. (MSA Research Corp., Callery, Penna.). May 15, 1964. Contract AT(11-1)-765. 25p.

The carburization diffusion coefficients are calculated for types 304 and 316 stainless steels tested in sodium saturated with carbon at 1200°F. This work is based on the results of 20-day tab tests and indicates diffusion coefficients of 1.81×10^{-11} cm^2/sec for type 316 and 3.99×10^{-11} cm^2/sec for type 304 stainless steel. The thick black films observed on the tabs and specimens included carbon concentrations from 3% at the surface to 0.5% at the edge of the film. The results indicate that the carburization of stainless steel appears to follow the basic theoretical diffusion relations. The results of preliminary operation of oxygenated sodium loop at high temperatures are reported. Information is presented on double break plugging curves, plugging indicator runs, failures, and chemical analysis. (N.W.R.)

24085 (NASA-CR-54053) THE CONTAINMENT OF MOLTEN LITHIUM HYDRIDE AT ELEVATED TEMPERATURES. Engineering Report. E. J. Vargo, D. B. Cooper, and J. B. Pearson, Jr. (Thompson Ramo Wooldridge Inc. TRW Electromechanical Div., Cleveland). Feb. 15, 1964. Contract NAS-5-462. 78p. (ER-5787)

The problems associated with the containment of molten lithium hydride, corrosion by lithium hydride, and the loss of hydrogen because of high hydrogen permeability of the container materials were investigated by a series of capsule tests. These tests, performed isothermally and at cyclic elevated temperatures, were operated for periods up to 5177 hours. The corrosive effect of lithium hydride was determined for two materials, Haynes alloy No. 25 and Type 316 SS. The hydrogen barrier effects of various coatings applied to the above materials also were evaluated from these capsule tests. The feasibility of using modified conventional techniques to form and join glass-coated metals such that a Sunflower system heat receiver and boiler could be fabricated was demonstrated. The favorable hydrogen permeability of a unique laminated tube structure also was demonstrated. From the data obtained in this investigation and the hydrogen permeability data obtained in an associated investigation, a selection of a satisfactory material for the containment of lithium hydride was made. The calculated loss of hydrogen to be expected after a one-year operation of the Sunflower system was 1.73 pounds or 13.84 pounds of lithium hydride. (auth)

24086 (NP-13898) OXIDATION RESISTANT HIGH TEMPERATURE PROTECTIVE COATINGS FOR TUNGSTEN. Quarterly Progress Report No. 3, November 15, 1963—February 15, 1964. (Thompson Ramo Wooldridge Inc. TRW Electromechanical Div., Cleveland). Contract AF33(657)-11151. 44p. (TM-3890)

Low pressure-high temperature characteristics of pre-oxidized (Si—W)—O coatings were found to be effected by the temperature of pre-oxidation. Coatings on W + (Si—W)—O systems, pre-oxidized under atmospheric conditions at 3000°F, showed general deterioration after 1 hour exposure at 3400—3500°F (corrected optical temperature) at a partial pressure (air of 25 microns. W + (Si—W)—O coated systems, pre-oxidized at 3350°F under atmospheric conditions, exhibited much less deterioration after low pressure exposure under the same conditions. W + Ti—Zr(Si—W) coated systems not converted prior to low pressure-high temperature exposure had less coating deterioration than either converted or converted and pre-oxidized W + Ti—Zr—(Si—W)—O systems. Scale up studies for deposition of (Si—W) coatings by the vacuum pack process were continued. Adjustment of conditions used to apply (Si—W) coatings by the vacuum pack process in the 7½ inch diameter by 18 inch retort resulted in a more uniform coating thickness deposited from top to bottom of the coating zone in the retort. The use of tungsten specimens having a greater mass than the standard ½ inch square test coupons improved heat transfer characteristics of the coating pack. A (Si—W) + (TiN—BN) coating system was formed on tungsten 60 mil sheet by plasma spraying a (TiN—BN) mixture on (Si—W) coated tungsten. Oxidation tests in air to 4000°F determined the ultimate capability of this system as 3650—3700°F. W + (Si—W)—O and W + Ti—Zr—(Si—W)—O coated systems, initially exposed in air at 3200°F, were subjected to dynamic low pressure erosion tests in the environmental chamber. Tests were conducted on each system at three different specimen to plasma gun distances without failure in one hour. (auth)

24087 (WADD-TR-61-72(Vol.XXX)) RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XXX. OXIDATION RESISTANT GRAPHITE BASE COMPOSITES. K. J. Zeitsch and J. M. Criscione (National Carbon Co. Advanced Materials Lab., Lawrenceburg, Tenn. and National Carbon Co. Research Lab., Parma, Ohio). Aug. 1963. Contract AF33(616)-6915. 77p.

Graphite base composites capable of resisting oxidation by forming a protective coating from their oxidation products are described. When first exposed to oxidizing conditions, the additives or graphite-additive reactants oxidize and form a coating, which protects the composite against further oxidation. Since these materials are homogeneous composites, they can be machined without destroying their oxidation resistant characteristics. The most effective additives investigated were combinations of ZrB_2, Si, B, Nb, and Th. All materials were prepared in a one step operation by hot pressing. The equipment required to fabricate graphite-refractory composites by hot pressing at temperatures up to 3100°C is described. Oxidation test methods employ indirect induction heating, resistance heating, arc image techniques, and electromagnetic levitation. (auth)

24088 (AEC-tr-6394) THE RESISTANCE OF MILD STEEL TO STRESS CORROSION WITH RESPECT TO AGING, HEAT TREATING, AND ALUMINUM CONTENT. Von Franz Nehl and Walter Werner. Translated by L. P. Costas (Savannah River Lab., Aiken, S. C.), from Stahl Eisen, 59: 1155-7(1939). 4p.

Studies were made on the effects of aging, heat treatment, and aluminum content on the stress corrosion resistance (SCR) of mild steel. The results showed that no relation exists between impact toughness of normalized and aged conditions on one hand and SCR on the other. Furthermore, the decrease of impact toughness due to aging does not correlate with SCR. Aluminum is beneficial only when added in excess of 0.04%. Non-aluminum killed steels, or those with little aluminum, can be made resistant by quenching from above the A_3 followed by 600 to 780°C annealing and air cooling as well as normalizing and annealing at 730 to 780°C followed by air cooling. Steels containing more than 0.15% C and quenched from above the A_3 are not resistant. Decarburization of the surface must be avoided as it promotes severe attack. (P.C.H.)

24089 STATIONARY POTENTIAL AND METAL CORROSION IN FUSED SALTS. M. V. Smirnov, V. P. Volodin, and I. N. Ozeryanaya. Dokl. Akad. Nauk SSSR, 155: 418-21(Mar. 11, 1964). (In Russian)

Thermodynamic equilibrium can exist at high temperatures between a metal and its corrosion product. The stationary potential $\phi_{\text{stat.}}$ of a metal and its corrosion rate (in amps/cm^2) can be expressed in terms of the oxidation-reduction potential E^0 (oxid/red) and the diffusion constants D (oxid) and D (red) as follows: $\phi_{\text{stat.}} = E^0 \text{ (oxid/red)} + RT/mF[(nFD(\text{red})/\delta i_{\text{corr}})(M/d)[\text{oxid}] - D(\text{red})/D(\text{oxid})]$. Here M and d are the molecular weight and density of the fused salt, and [oxid] is the mole fraction of oxidant in the fused salt. The stationary potential of metallic zirconium in an equimolar salt mixture of NaCl−KCl in an atmosphere of pure argon was measured at 700, 800, and 900°C. The results fit the following empirical equation: $\phi_{\text{stat.}} = 2.47 - 2.2 \times 10^{-4}$ T volts. The corrosion rate was determined experimentally, and also calculated from the above equation. The calculated results were in good agreement with the experimental values. The corrosion rates were 3.3 g · cm^{-2} hr^{-1} at 700°C, 6.0 g · cm^{-2} hr^{-1} at 800°C, and 8.0 g · cm^{-2} hr^{-1} at 900°C. An analogous behavior was observed for beryllium, titanium, hafnium, and uranium. (TTT)

24090 THERMAL OXIDATION OF NUCLEAR GRAPHITE. J. B. Lewis, P. Hawtin, and R. Murdoch (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Brit. Nucl. Energy Soc., 3: 95-8(Apr. 1964).

A knowledge of the thermal reactivity of the graphite core is required in order to be able to predict the consequences of an accident to a CO_2 cooled graphite moderated reactor in which there is loss of coolant pressure and ingress of air. The reactivity of the graphite is measured at intervals by means of a standard monitoring test, but various chemical and physical factors need to be known before the reactivity appropriate to fault conditions in a reactor can be calculated from the monitoring data. These factors are described and discussed. (auth)

24091 A LIMITED REVIEW OF REFRACTORY ALLOY CORROSION TESTS IN POTASSIUM. R. G. Carlson, W. F. Zimmerman, and R. G. Frank (General Electric Co., Evendale, Ohio). 10p. (CONF-373-11)

From Technical Conference on Applied Aspects of Refractory Metals, Los Angeles, Dec. 1963.

Some observations and overall results on the effects of potassium on potential containment and turbine alloys are reported. Three types of test procedures were used: isothermal capsule tests; reflux capsule tests; and thermal convection loops. Alloys that were evaluated as specimen materials, in both the recrystallized and stress-relieved conditions were Nb−1Zr, Nb−752, F−48 (Nb + 15W + 5Mo + 1Zr + 0.04C), and TZM (Mo + 0.5Ti + 0.08Zr), and As-55 (Nb + 5W + 1Zr + 0.06C + 1Y). In general, the alloys in isothermal capsule tests did not exhibit any significant corrosive attack. However, K caused some effects on the hardness, strength, and embrittlement of the alloys. The results of reflux capsule tests indicated only small amounts of corrosive attack. Also, there was little evidence of corrosive attack, mass transfer, or loss at room temperature in the thermal convection loop tests. (P.C.H.)

24092 IMPROVEMENTS IN OR RELATING TO PROCESSES FOR THE PROTECTION OF METALS AGAINST CORROSION AT HIGH TEMPERATURE. Francis Schein and Bernard Le Boucher (to Institut Francais du Petrole des Carburants et Lubrifiants). British Patent 956,915. Apr. 29, 1964. Priority date May 26, 1961, France.

A process for the protection of metals against corrosion by gases at high temperatures is patented. A potential difference is applied across 2 electrodes, the negative electrode being the metal to be protected and the positive electrode being a solid in direct contact with a layer of corrosion product on the metal. The solid should have a higher conductivity than the corrosion product. The corrosion product may be an oxide, sulfide, or inorganic salt of the metal, and it does not have to be similar to that which would form on the metal without the use of the protective process. The current density should be at least 0.01 ma/cm^2. (M.P.G.)

Fabrication

24093 (AD-424593) COLUMBIUM ALLOY SHEET ROLLING PROGRAM. Interim Report No. 4, September 7−November 6, 1963. H. L. Kohn and R. M. Curcio (Fansteel Metallurgical Corp., North Chicago, Ill.). Nov. 7, 1963. Contract NOw-63-0231-c. 11p. (N64-13109)

Conversion of FS-85 (Nb−27Ta−10W−1Zr) from sheet bar to finished 18-in. wide by 0.060-in. thick sheet is completed. Data are presented. Further processing of B-66 (Nb−5V−5Mo−1Zr) from the extruded sheet bar stage is described. (auth)

24094 (AD-436324) THE STRESS-STRAIN BEHAVIOR OF STRONTIUM ZIRCONATE. Bimonthly Progress Report No. 3, January 15−March 15, 1964. J. E. Funk, J. Nemeth, and J. R. Tinklepaugh (New York. State Univ. Coll. of Ceramics, Alfred). Contract NOw64-0051-d. 11p.

Success has been achieved in sintering C.P. $SrZrO_3$. Mechanical grinding was apparently necessary to facilitate sintering. The impurity pickup was low enough not to be detectable. Small single crystals have been grown from a salt flux by seeding with a few small grains of $SrZrO_3$. (auth)

24095 (AI-8700(Vol.I)) ESADA FUEL FABRICATION DEVELOPMENT PROGRAM. TERMINAL REPORT. VOLUME I. PROGRAM SUMMARY— FABRICATION AND COST ANALYSIS. D. K. Magnus (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 30, 1963. 29p.

A fabrication and cost analysis for uranium carbide fuels for the Sodium Graphite Reactor is presented. Advantages and disadvantages of uranium carbide for use as a reactor fuel are outlined. It was concluded that the objective of a fabrication cost of $100/kg of contained uranium was achieved. The fabrication process consisted of carbothermic reduction of UO_2, followed by arc melting and casting into uranium carbide slugs. (M.C.G.)

24096 (AI-8700(Vol.II)) ESADA FUEL FABRICATION DEVELOPMENT PROGRAM. TERMINAL REPORT. VOLUME II. UC MELT STOCK—DEVELOPMENT AND PRODUCTION. J. W. Carroll (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 30, 1963. 32p.

An economic process for the synthesis of a uranium−carbon alloy, to be used as melt stock in the production of arc-melted and cast UC fuel slugs, was developed. The process embodies: intimate mixing of nuclear quality, ceramic grade UO_2 with nuclear grade powdered graphite; agglomeration of the mixture; and the carbothermic reduction of the UO_2 in a vacuum induction furnace. A total quantity of approximately 4300 kg of UC_x was synthesized. Of this quantity, 2000 kg was synthesized to obtain production cost and yield data. (auth)

24097 (AI-8700(Vol.III)) ESADA FUEL FABRICATION DEVELOPMENT PROGRAM. TERMINAL REPORT. VOLUME III. URANIUM CARBIDE SLUG FABRICATION—DEVELOPMENT AND PRODUCTION. D. H. Turner

(Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 30, 1963. 80p.

A two-phase program, aimed at developing and demonstrating an economic process for the production of uranium carbide fuel slugs, is described. The process is based upon carbon-arc skull casting of presynthesized UC melt stock. A technique for dry machining of cast UC slugs was developed. Fuel slugs for 20 prototype fuel elements, using depleted uranium, were produced under conditions designed to demonstrate the economic potential of the developed manufacturing process. Handling and processing criteria for 4.0 wt % enriched material were followed throughout all phases of manufacture. The fuel elements were designed for use in a large advanced sodium graphite reactor. (auth)

24098 (AI-8700(Vol.IV)) ESADA FUEL FABRICATION DEVELOPMENT PROGRAM. TERMINAL REPORT. VOLUME IV. UC FUEL ROD, ELEMENT, AND ASSEMBLY—DEVELOPMENT AND PRODUCTION. W. Draganchuk and S. M. Cobb (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 30, 1963. 62p.

An economically attractive process was developed and demonstrated for the production of stainless steel-clad, sodium-bonded, uranium carbide fuel elements, for use in large sodium graphite reactors. Over 400 fuel rods for full-scale 18-rod elements were produced, and elements were assembled at a rate of approximately five per week, to demonstrate the process and associated costs. (auth)

24099 (DMIC-199) THE APPLICATION OF HIGH PRESSURE IN METAL-DEFORMATION PROCESSING. Report on an Informal Symposium of the Metalworking Processes and Equipment Program. F. W. Boulger and B. A. Wilcox (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Mar. 2, 1964. Contract AF33(615)-1121. 72p.

On October 3, 1963, a symposium was sponsored by the Bureau of Naval Weapons, Metalworking Processes and Equipment Program, on the application of high pressure in metal-deformation processing. Informal talks were given by eight investigators actively working in the field, covering both fundamental and applied aspects of high pressure effects. Past research, largely by Bridgman, showed that superimposed hydrostatic pressure can significantly increase the ductility at fracture of various materials. These observations stimulated interest in applying this hydrostatic pressure effect to metal deformation processing, where it was anticipated that improved ductility and fabricability of brittle materials could be realized. Hydrostatic extrusion and hydrodynamic compressive forging were two such fabrication techniques discussed and preliminary results were found to be encouraging. Although it was generally observed that testing under high pressure improves the ductility to fracture, it was noted that pressure cycling did not improve either the strength or ductility of steels containing various amounts of carbon. In addition to the mechanical-property effects, hydrostatic pressure was found to affect measurably, numerous metallurgical properties of metals and alloys. These include modes of deformation; kinetics of recovery, recrystallization, and grain growth; and phase stability. (auth)

24100 (HW-SA-3146) WELDING PLUTONIUM-CONTAINING FUEL ELEMENTS. L. C. Lemon, W. T. Ross, and W. J. Bailey (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 8, 1963. Contract AT(45-1)-1350. 47p. (CONF-511-1)

From American Welding Society 45th Annual Meeting, Detroit, Mar. 1964.

Welding techniques were developed at Hanford to fusion weld or seal plutonium-containing fuel materials clad with Zircaloy, aluminum, and stainless steel. Experience showed that plutonium can be safely and routinely handled in hoods or sealed glove boxes, which are maintained at a slightly negative pressure. Methods of welding and testing each cladding are described. (M.C.G.)

24101 (LAMS-3065) FEASIBILITY STUDY OF THE CO-EXTRUSION OF REFRACTORY METAL CLAD REACTOR FUEL ELEMENTS. J. M. Dickinson and T. J. Ready (Los Alamos Scientific Lab., N. Mex.). Apr. 12, 1964. Contract W-7405-eng-36. 18p.

High-velocity co-extrusion was demonstrated to be a suitable method of fabricating a 45 vol % UO_2-tungsten cermet and simultaneously cladding it with a refractory metal. Several rods were made using co-extrusion ratios of from four to nine, and good metallurgical bonds were obtained between the cermet core and the refractory metal cladding. Cladding materials used included molybdenum and molybdenum–tungsten alloys. A co-extruded rod clad with a 25% Mo–tungsten alloy was given a 75% reduction in area by warm swaging, and a typical cold-worked structure was produced, while maintaining an excellent bond between the cladding material and the cermet core of the rod. (auth)

24102 (TID-20625(Vol.I)) WELDING PROCEDURES. VOLUME I. Procedure Specifications, Welding Procedures, and Procedure Qualification Test Records. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [nd]. Contract [AT(45-1)-1350]. 285p. (HWS-7170; HWS-7171; HWS-7172).

A standard method is outlined by which qualifications may be established for welding procedures, welders, and welding operators. The procedures are applicable to pressure vessel fabrication on-site, pressure piping, and other fabrications requiring formal welding procedures. Examples of documents required to qualify for weld fabrication are presented. Welding procedures and procedure specifications relating to specific materials, processes, and applications are covered. Responsibilities, code requirements, establishing a welding procedure, establishing welder performance qualification, procedure specifications, and most commonly used basic weld joints and applications are discussed. Procedure specifications, welding procedures, and procedure qualification test records are presented for HWS-7171 and HWS-7172 series. An index is included. (M.C.G.)

24103 (TID-20625(Vol.II)) WELDING PROCEDURES. VOLUME II. Procedure Specifications, Welding Procedures, and Procedure Qualification Test Records. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [nd]. Contract [AT(45-1)-1350]. 263p. (HWS-7173; HWS-7174; HWS-7175; HWS-7176; HWS-7177).

Procedure specifications, welding procedures, and procedure qualification test records are presented for HWS-7173 through HWS-7177 series. An index is included. (M.C.G.)

24104 (TID-20625(Vol.III)) WELDING PROCEDURES. VOLUME III. Procedure Specifications, Welding Procedures, and Procedure Qualification Test Records. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [nd]. Contract [AT(45-1)-1350]. 291p. (HWS-7178 through HWS-8095)

Procedure specifications, welding procedures, and procedure qualification test records are presented for HWS-

7178 through HWS-7189 and HWS-7600, HWS-7680, and HWS-8090 through HWS-8096. (M.C.G.)

24105 (JPRS-24521) STUDIES IN WELDING OF TITANIUM AND NIOBIUM. Translated from Svarka Tsvetn. Metal. i Splavov, Sb. Statei, 72-110(1961) and Avtomat. Svarka, No. 1, 25-27(1964). 67p. (OTS-64-31229).

Translations of two articles from Russian-language publications, Svarka Tsvetn. Metal. i Splavov, Sb. Statei and Avtomat. Svarka, are presented. One paper was previously abstracted for NSA as 18-22465. An abstract of the remaining paper was prepared. (M.C.G.)

For abstract of an individual paper see: 24106.

24106 (JPRS-24521(p.1-58)) WELDING OF TITANIUM ALLOYS. M. V. Poplavko, N. N. Manuylov, and L. A. Gruzdeva. Translated from Svarka Tsvetn. Metal. i Spavov, Sb. Statei, 72-110(1961).

Methods of welding titanium and its alloys are described. Topics covered include: preparing the surface for welding, fusion welding, contact electric welding, argon-arc welding, weld quality, heat treatment of welded parts, and effects of gases and alloying elements on properties of welded joints. (M.C.G.)

24107 (SC-T-64-903) ELECTROLYTICAL POLISHING APPLICATION IN METALLOGRAPHY. A. L. de Sy and H. Haemers. Translated for Sandia Corp., Albuquerque, N. Mex., from Metalen, 4: 129-37(1950. 21p.

Mechanisms and uses of electrolytic polishing are described. Results for the electrolytic polishing of copper in phosphoric acid are presented. Methods of polishing iron, steel, aluminum, aluminum alloys, copper, and copper alloys are discussed. (M.C.G.)

24108 WELDING VACUUM-ARC-MELTED AND ELECTRON-BEAM-MELTED COLUMBIUM. E. I. Istomin and Yu. P. Gumenyuk. Avtomat. Svarka, No. 1, 25-7 (1964).

An experimental study of the weldability of niobium and suitable welding methods is reported. Specimens 1-mm thick were butt-welded by an electron beam in a 2 × 10^{-5}-torr vacuum with 45 ma at 20 kv, at a rate of 30 m/hr, weld width 1.5-1.8 mm. Other 1-mm thick specimens were argon-arc butt-welded with 140 amp, 10 v, 35 m/hr, weld width 2.5-3.0 mm, by a 3-mm tungsten electrode. Both welds had a neat appearance, without undercuts or oxidation stains. It was found that both types of Nb can be successfully welded by either electron-beam or argon-arc welding; the strength of the vacuum-arc-melted columbium exceeds that of the electron-beam Nb by 60 or 70 HV. Sheet vacuum-arc Nb should preferably be welded by the electron-beam method since argon-arc welding increases the impurity content and sharply reduces plasticity. (OTS)

24109 A NOTE ON THE INFLUENCE OF LOCAL VARIATIONS IN O/U RATIO DURING UO_2 PELLET SINTERING. I. Amato and R. L. Colombo (FIAT, Turin). Energia Nucl. (Milan), 11: 217(Apr. 1964).

Evidence is given showing that in hydrogen sintered UO_2 pellets the central regions exhibit higher O/U ratios than the skin. An explanation for the fact is given. As a result, a grain size gradient in addition to the density gradient shows up in hydrogen sintered pellets. (P.C.H.)

24110 PRÉPARATION OF ZIRCONIUM INSERTION PIECES WITHOUT PRELIMINARY ANNEALING. E. S. Borisovskii and G. M. Khosid. Ogneupory, No. 2, 59-62 (1964). (In Russian)

Preparation of high-resistance zirconium manufacturing materials pressed from large-grain zirconium powder (TsMTU−2002−47) mixed with fine-grain (TsMTU−4469−54) without preliminary treatment and annealing was described. (R.V.J.)

24111 HIGH-THERMAL RESISTANCE OF LARGE FINISHED PRODUCTS MANUFACTURED FROM ZrO_2. O. M. Margulis, I. F. Usatkov, and A. B. Kamenetskii (Ukrainian Research Inst. of Refractory Materials, Academy of Sciences, USSR). Ogneupory, No. 2, 63-7(1964). (In Russian)

Thermal resistance of zirconium specimens prepared by mixing cubic briquettes and monoclinic zirconium dioxide grains and annealing at 1750°C was analyzed. (R.V.J.)

24112 THE SOLID-STATE BONDING OF REFRACTORY METALS. A. T. D'Annessa (Lockheed Missiles and Space Co., Palo Alto, Calif.). Welding J. (N. Y.), 43: 232s-40s (May 1964).

An investigation was made on solid-state bonding using a vacuum-hot-pressing technique of the Mo−0.5% Ti alloy and unalloyed Mo and W. Unalloyed interface metals (0.001 in. foil) were used to obtain activated-diffusion at temperatures below the recrystallization temperatures of the base metals. A surface conditioning treatment (cold-grinding) of the base metal substrates was used to enhance diffusivity and to improve bonding characteristics. Various bonding pressures were evaluated to establish a minimum practical pressure range with which completeness of bond could be obtained. Bonding temperatures were established for each diffusion system using a minimum temperature (below 1850°F)-minimum time-at-temperature (20 min) criterion. Bonding parameters were established for the Mo−0.5 Ti/Ni, Mo−0.5 Ti/Ti, Mo−Nb, Mo−Moly Permalloy, W−Ni, W−Ti, and W−Nb diffusion systems (couples). A W−Ni−Nb−W diffusion composite was also investigated. It was concluded that for sustained high-temperature application, the W−Ti and W−Nb systems would be ones of minimum diffusion activity. For transient high-temperature requirements, any of the systems might find suitable application in the as-bonded condition. (P.C.H.)

24113 IMPROVEMENTS IN OR RELATING TO WELDING. Harold Rogan and James Halliwell (to United Kingdom Atomic Energy Authority). British Patent 956,083. Apr. 22, 1964. Filed Apr. 16, 1962.

A method of welding end caps to the tubular sheath of a reactor fuel element is patented. The end cap is positioned in the end of the sheath so that it projects out beyond the end of the sheath. The 90° angle between the outer surface of the end cap and the end of the sheath is then filled with an annular weld. The thickness of the projecting portion of the end cap and the sheath wall should be similar. The end cap is correctly positioned in the end of the sheath by shoulders inside the sheath, which prevent the end cap from entering the sheath more than the desired amount. (M.P.G.)

24114 PYROLYTIC GRAPHITE ARTICLE. Edward Roy Stover (to General Electric Co.). British Patent 956,342. Apr. 22, 1964. Filed Oct. 25, 1962.

A method of fabricating a pyrolytic graphite article as a composite structure is patented. The article is formed so that its exposed surfaces are perpendicular or at an acute angle to the plane of deposition of the graphite crystallite layers. This prevents the layers from being sheared apart and lengthens the life of the article. The article is composed of pyrolytic graphite plates, which are stacked so that their planes of deposition are parallel to each other and perpendicular or at an acute angle to the free surfaces of the article. The plates may be bonded together by a separately deposited pyrolytic graphite coating between each pair of plates. The composite article may be made in the form of a rocket nozzle, each plate being a ring with its plane of deposition perpendicular to the axis of the nozzle. (M.P.G.)

24115 COATED URANIUM DIOXIDE. (to U. S. Atomic Energy Commission). British Patent 957,354. May 6, 1964. Priority date Mar. 16, 1961, United States.

A method of coating particles of UO_2 with a layer of porous Al_2O_3 and an outer layer of impermeable α-phase Al_2O_3 is patented. The porous layer is deposited by hydrolyzing Al_2Cl_6 in the presence of H in a vessel containing a fluidized bed of UO_2 particles. The reaction is maintained at cycled temperatures of 200 to 900°C in the lower part of the bed where the reactants mix until the porous coating is the desired thickness. The vessel is then vented to stop the formation of the porous layer, and the hydrolyzing is resumed at cycled temperatures of 900 to 1400°C to vapor deposit a layer of α-phase Al_2O_3 over the porous layer. The UO_2 particles should be 50 to 400μ in size. The coated particles in a graphite matrix are suitable as fuel elements in a pebble-bed reactor. (M.P.G.)

24116 IMPROVEMENTS IN OR RELATING TO THE FABRICATION OF NUCLEAR REACTOR FUEL ELEMENTS. Herbert Noel Jones and Ian Cochran Campsie (to United Kingdom Atomic Energy Authority). British Patent 957,605. May 6, 1964. Filed Feb. 10, 1960.

A process is patented for the manufacture of reactor fuel elements, in which the sheath and fissile material were forced into close contact during manufacture by external pressurization at an elevated temperature. During pressurization, the fuel element is held in a clamp that applies a longitudinal compressive stress to the sheath. The clamp is made of 2 or more materials so that its thermal expansion matches that of the fissile material. This requires the sheath to elongate by approximately the same amount as the fissile material during heating and pressurization and prevents gaps between the fuel member and end caps. The clamp consists of a tubular body of stainless and mild steel with end caps, between which the fuel element is clamped in the tubular body. Fittings may be provided for clamping fuel elements with heat-transfer fins. (M.P.G.)

24117 PROCESS OF MAKING AN IMPERMEABLE COMPOSITE CARBON TUBE. Robert Lewis Bickerdike, Anthony Reginald George Brown, Garyth Hughes, William Johnson, and William Watt (to United Kingdom Atomic Energy Authority). U. S. Patent 3,132,979. May 12, 1964. Priority date Feb. 10, 1959, Great Britain.

A process is given for making an impermeable composite carbon tube from porous component carbon tubes. The process comprises depositing carbon in the pores of the surface of one component tube, uniting the treated tube with the other component tubes by means of an adhesive (preferably furfuryl alcohol), and heating the composite tube to polymerize and carbonize the adhesive. (D.L.C.)

Properties and Structure

Refer also to abstracts 24557, 24854, and 24860.

24118 (AD-418388) A STUDY TO DETERMINE THE DEFORMATION CHARACTERISTICS OF BERYLLIUM AND TUNGSTEN UNDER CONDITIONS OF HIGH HYDROSTATIC PRESSURE. Final Report, November 14, 1962–May 14, 1963. (Pressure Technology Corp. of America, Woodbridge, N. J.). Sept. 1963. Contract N600(19)59430. 59p.

Studies on the deformation of tungsten and beryllium under fluid pressure by tensile, compressive, and fluid-to-fluid extrusion tests yielded information on stresses and maximum deformations as a function of pressure. Pressure was found to increase the number of modes of deformation of monocrystalline beryllium. Accompanying analyses and suggestions for use in metalworking are given. (auth)

24119 (AD-425148) THE USE OF STRAIN SOFTENING TO IMPROVE THE PROPERTIES OF REFRACTORY METALS. Final Report. E. J. Ripling and S. Mostovoy (Materials Research Lab., Inc., Richton Park, Ill.). Nov. 1963. Contract NOw-62-0725-c. 12p. (N63-19632)

A molybdenum–0.5 titanium alloy was subjected to an increasingly large number of passes with a constant work-roll size. The property improvement went through a maximum at a relatively low number of passes (ten). Attempts to measure surface strains by use of a ruled grid yielded results that were too coarse to experimentally relate strain to work-roll diameter. The unnotched tensile properties of the tungsten sheet were evaluated as a function of testing temperature. (auth)

24120 (AEET/CD/21) STUDIES OF THE ELECTRICAL PROPERTIES OF URANIUM OXIDES. II. ELECTRICAL CONDUCTIVITY AND THERMOELECTRIC POWER OF δ–U_3O_8. A. M. George and M. D. Karkhanavala (India. Atomic Energy Establishment, Trombay). 1963. 12p.

The results of electric conductivity and thermoelectric power measurements on δ–U_3O_8 up to 600 and 400°C, respectively, are reported. The conductivity plot showed four temperature regions with a discontinuity at 115 to 120°C. The activation energies for the different regions were calculated. The thermoelectric power was positive and showed a strong maximum of 16.5 μv/°C at about 115°C and a weaker maximum at 180°C. It finally changes sign around 350°C. (auth)

24121 (ANL-6804) FIELD EMISSION FROM SINGLE CRYSTALS OF GRAPHITE. G. Montet, M. Hoch, and G. Hennig (Argonne National Lab., Ill.). Feb. 1964. Contract W-31-109-eng-38. 16p.

The surface conditions of graphite were studied with a field-emission microscope. The emitting tips were "Knife-edges" of graphite platelets. The emissions characteristic of clean edges and of edges covered by an oxide film were studied, and some qualitative information of relative work functions of these surfaces was obtained. Attempts to extend these observations are described. (auth)

24122 (ASD-TDR-63-371) RELATION BETWEEN SPECIFIC HEAT AND EMISSIVITY OF TANTALUM AT ELEVATED TEMPERATURES. Michael Hock and H. V. L. Narasimhamurty (Cincinnati. Univ.). Mar. 1963. Contract AF33(616)-7123. 31p. (AD-414194)

The rate of cooling in vacuum of tantalum cylinders of various sizes was studied in the temperature range 1850 to 1300°K. The ratio of specific heat, C_p, to total emissivity, ϵ, was found to be constant: $C_p/\epsilon = 0.226 \pm 0.004$ cal/gm/°K. (auth)

24123 (ASD-TDR-63-676) ON THE EFFECTS OF ANNEALING AND GRAIN SIZE IN POWDER-METALLURGY TUNGSTEN. Friedrich G. Ostermann (Research and Technology Div. Air Force Materials Lab., Wright-Patterson AFB, Ohio). July 10, 1963. 34p. (AD-422980; N64-11769)

Mechanical properties of powder-metallurgy tungsten were studied at low temperatures. Particular emphasis was placed on the effects of annealing temperatures and grain size on the ductile-brittle behavior. While room-temperature hardness and grain size were little sensitive to temperature changes within the 1500 to 2300°C range, tensile behavior was markedly influenced. Variation of grain size was achieved by straining and annealing. Grain size effects were evaluated in terms of the Petch-analysis. The k_y-parameter was found to be 4.5×10^7 dynes/$\text{cm}^{3/2}$, and an effective surface energy of 11,000 ergs/cm^2 for crack propagation was determined. Fracture was at all times predominantly intergranular. The results suggest that the high ductile-brittle transition temperature of tungsten is not sufficiently explained by strong dislocation-impurity atom interaction. (auth)

24124 (CEA-2341) ETUDE DES TRANSFORMATION DES ALLIAGES URANIUM–NIOBIUM À FAIBLE TENEUR EN NIOBIUM TREMPÉS DEPUIS LES DOMAINES GAMMA ET BÊTA + GAMMA 1 PUIS REVENUS À DIFFÉRENTES TEMPÉRATURES. COMPARAISON AVEC LES ALLIAGES URANIUM–MOLYBDÈNE. (Study of the Transformation of Uranium–Niobium Alloys With Low Niobium Concentrations, Tempered From the Gamma and Beta + Gamma 1 Regions and Then Annealed at Different Temperatures. Comparison With Uranium–Molybdenum Alloys). Claude Collot (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1963. 53p.

Thesis submitted to Université, Nancy.

It is shown that uranium–niobium alloys, like uranium–molybdenum alloys, tempered from the gamma region, give a mertensitic phase with a structure deriving from that of alpha–uranium by a slight contraction parallel to the axis [001]. The critical cooling rate allowing the formation of this martensite is 80°C/sec at 750°C. Retention of the beta phase of uranium–niobium alloys is difficult since the critical retention rate is 700°C/sec at 668°C for an alloy containing 2.5 at. % Nb. This beta phase is completely converted to the alpha phase at room temperature in about 6 hours. The TTT curves of this beta alloy are effectively reduced. The beta phase conversion law is expressed as: $1 - x = \exp. - (kt)^n$, where x is the degree of progression of the conversion, t the time, n an exponent nonvarying with temperature and having approximately the value 2 for the alloy considered, and k an increasing function of temperature. The activation energy of conversion is of the order of 14,600 cal/mole. Niobium was found to be much less active than molybdenum as a stabilizer of beta–uranium. (auth)

24125 (CEND-3256-209) CORRELATIONS BETWEEN SENSITIZATION AND STRESS CORROSION CRACKING OF 300 SERIES STAINLESS STEELS. Progress Report, January–March 31, 1964. R. C. Brayer, G. Zuromsky, and W. P. Chernock (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Apr. 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-3256. 34p. (EURAEC-1073)

Tests of Types 304 and 347 stainless steel in both the solution-annealed and sensitized conditions were initiated in pressurized water containing 15 ppm dissolved oxygen and 25 ppm chloride ion. The unstressed samples indicated no attack after exposure to this environment for 180 hours at 190°C. These samples have been stressed to half the yield point and are in test under the same environmental conditions. Preparation of internally pressurized tubular samples is nearing completion. Refinements to the steam test apparatus have been completed and results from initial testing of the system have been satisfactory. (auth)

24126 (CONF-405-32) LAVES PHASES OF THE RARE EARTHS WITH TRANSITION ELEMENTS. Rodney P. Elliott (Illinois Inst. of Tech., Chicago. IIT Research Inst.). [1961]. Contract AT(11-1)-578. 32p.

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

The alloying characteristics of the rare earth elements with the transition metals undergo a radical change as the atomic number of the transition series increases, transition elements in Groups IVa, Va, and VIa are immiscible with the rare earths, while elements of Groups VIIa, and VIIIa, VIIIb, and VIIIc form many compounds. Since this cannot be correlated with a size effect, an explanation postulated for this behavior is a valency or electronegativity effect. Those binary systems forming compounds form "Laves phases," which can exist in one of three related crystal structure types: $MgCu_2$, $MgZn_2$, or $MgNi_2$. The specific Laves-type crystal structure can be related to the average free electron concentration, a phenomenon that was used to calculate electronic valency of the transition elements. A compilation of the known Laves-type phases occurring between rare earth elements and transition metals supported the hypothesis that the valency effect is operative. Additional rare earth-transition metal compounds previously unknown were prepared and found to be consistent with the previously noted trend. On the assumption that a critical electron/atom ratio determines which Laves-type structures are stable, the periodical grouping of the Laves-type species of the rare earth-transition metal compounds indicated a slight but regular increase in valency as the atomic number of the rare earth increased. Ternary alloys prepared between the Laves phases of different structure types substantiate the observed valency trend. (auth)

24127 (CONF-405-33) RARE EARTH–POLONIUM-210 SYSTEMS. C. J. Kershner, R. F. Heidelberg, and R. H. Steinmeyer (Mound Lab., Miamisburg, Ohio). [1963]. Contract AT(33-1)-Gen-53. 12p.

From the 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

The synthesis products of polonium and rare earths were obtained as finely divided black powders, which were easily oxidized in air. This oxidation behavior was undoubtedly enhanced by the large surface area of the particles and self-heating of the radioactive ^{210}Po. The polonides all melted incongruently with rapid loss of polonium at or above their melting points. A polonium dissociation pressure greater than 10^{-3} mm Hg was detected at 1000°C for all the prepared polonides except those of lanthanum, cerium, praseodymium, neodymium, gadolinium, dysprosium, thulium, and lutetium. The dissociation behavior was displayed by the shape of the gamma trace obtained from the unreacted polonium distillation portion of the reaction. The distillation slopes at 1000°C were nearly vertical, whereas dissociations appeared as very slight decreases in gamma activity in the reaction chamber. Although the synthesis procedure for this study was specifically designed to produce the most thermally stable compounds of polonium and rare earth metals, stoichiometric ratios other than the observed one-to-one are considered probable. The thermal stabilities and melting points of the one-to-one rare earth polonides were lower than for the corresponding tellurides and selenides, and were in keeping with the expected decrease in ionic character of chalcogen-rare earth bonding for the heaviest member of the group. (auth)

24128 (CONF-405-34) THE MAGNETIC STRUCTURES OF RARE EARTH MANGANITES RMnO$_3$. W. C. Koehler, H. L. Yakel, E. O. Wollan, and J. W. Cable (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 18p.

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

The crystal structures and ferroelectric properties of the RMnO$_3$ compounds, with R = Ho, Er, Tm, Yb, Lu, and Y, were previously reported. The magnetic configurations of the manganese ion moments in representative members of this series as well as in the isostructural compound ScMnO$_3$ are described. Neutron diffraction data on polycrystalline samples revealed transitions from a paramagnetic to an antiferromagnetic state at temperatures ranging from 76°K for HoMnO$_3$ to approximately 120°K for ScMnO$_3$. The magnetic configurations adopted by the moments in these compounds are "triangular" arrangements similar to those discovered by Corliss et al. in CrSe. The magnitudes of the moments are slightly smaller than the expected value of 4 Bohr magnetons and the moment directions are parallel or nearly parallel to the basal planes of the hexagonal structure, but they make various angles, depending upon the compound, with the hexagonal axes in the basal plane. (auth)

24129 (CONF-524-5) THE EFFECT OF TWINNING ON THE YIELD STRESS OF POLYCRYSTALLINE IRON AT LOW TEMPERATURES. S. B. McRickard and J. G. Y. Chow (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract AT(30-2)-Gen-16. 12p.

From American Institute of Mining, Metallurgical and Petroleum Engineers Annual Meeting, New York, Feb. 1964.

A study of the twinning stress of iron with several grain sizes at low temperatures was undertaken. Results indicated that the onset of twinning produces no discontinuity effect in the variation of yield stress with temperature. The twinning stress curve intersected the slip-activated yield stress curve at about 120°K. (M.C.G.)

24130 (D2-22437) AN APPROACH TO THE PREDICTION OF PRESSURE VESSEL MINIMUM FATIGUE LIFE BASED UPON APPLIED FRACTURE MECHANICS. C. F. Tiffany and F. A. Pall (Boeing Co., Seattle). [Mar. 1963]. 36p.

A method for predicting minimum pressure vessel fatigue life is presented. The approach is based on the fact that small surface or internal flows usually are present in the pressure vessels, and with multiple stress cycles, they grow to critical size and failure results. Prediction of the vessel life therefore depends on knowledge of initial flow sizes, critical sizes, and cyclic flow growth characteristics of the materials. It is shown how this information can be obtained. The usefulness of the stress intensity concept in relating round notch bar fatigue test data to the cyclic flow growth in pressure vessels is shown. Predicted cyclic flow growth curves for an aluminum alloy and steel are included. (M.C.G.)

24131 (EURAEC-921) MECHANISMS OF DIFFUSION AND PRECIPITATION OF HYDROGEN IN ZIRCONIUM. Quarterly Report No. 4, October 1 to November 30, 1963. (Bologna. Universita. Istituto di Fisica "A. Righi."). Work performed under United States–Euratom Joint Research and Development Program. Contract 051-62-11-RDI. 56p.

The hydrogenation of zirconium is studied by electron microscopy, x-ray diffraction analysis, electric conductivity measurements, optical microscopy, hydrogen absorption through oxide films, quenching-deformation techniques, and diffusion and precipitation mechanisms. The results of these studies are discussed along with testing equipment developed for testing purposes. (N.W.R.)

24132 (HW-81752) STANDARDIZATION AND EVALUATION OF A GRAIN SIZE TEST FOR URANIUM FUEL (thesis). R. D. Spice (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 21, 1964. Contract [AT(45-1)-1350]. 20p.

The selection of "standard" fuel cores for calibrating an ultrasonic tester used to measure the grain size of uranium cores prior to cladding for use as reactor fuel elements is described. It was found that more accurate results can be obtained from the tester when the calibration standards have nearly the same diameter as the fuel cores being production tested. The physical positioning of the transmitting and receiving transducers was found to be critical. (M.C.G.)

24133 (LADC-6391) THE HIGH TEMPERATURE CHEMISTRY OF REFRACTORY CARBIDES AS DETERMINED BY HIGH TEMPERATURE TECHNIQUES. Melvin G. Bowman (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 18p. (CONF-517-1)

From 5th Plansee Seminar-Reutte, Tyrol, Austria, June 1964.

Equipment and techniques were developed, which permit better detection of phase changes and elucidation of phase diagrams by means of high temperature observations. The advantages of high temperature thermal analysis and high temperature neutron diffraction were demonstrated in observations made on the uranium-carbon system and ternary uranium-zirconium-carbon systems. General descriptions of the apparatus and techniques are presented. (auth)

24134 (NMI-1257) FUNDAMENTALS OF SINGLE-CRYSTAL DEFORMATION IN ZONE-REFINED BERYLLIUM. Final Report, July 1, 1962 through June 30, 1963. D. F. Kaufman and L. R. Aronin (Nuclear Metals. Div. of Textron Inc., West Concord, Mass.). May 8, 1964. Contract AT(30-1)-2784. 28p.

The study of the fundamental deformation characteristics of zone-refined beryllium single crystals has been continued with particular emphasis on evaluation of material of higher purity and on the study of purified crystals to which alloying additions have been made. A crystal of high purity was obtained by subjecting distilled beryllium to 12 zone-refining passes. This material (R$_{298}$/R$_{4.2}$ = 1300 max) exhibited significant improvements in mechanical properties in basal slip. Glide strains in excess of 175 percent were observed, and increased resistance to cleavage was manifest in the complex fractures occurring in the grip regions of tensile specimens. In a series of "c" axis compression tests on zone-refined crystals in the temperature range 400 to 700°C, no new modes of deformation which would relieve plastic anisotropy were seen to operate. These tests were conducted on directly consolidated six-pass SR-flake beryllium with a purity level represented by a resistance ratio of R$_{298}$/R$_{4.2}$ = 250. In contrast to the extreme brittleness exhibited by commercial-purity material tested in "c" axis compression, the zone-refined material exhibited gross deformation by basal slip and shear. Additions of iron and silicon were made individually and in combination to six-pass zone-refined SR-flake beryllium. Iron additions at the 1000 ppm level increased the critical resolved shear stress for basal slip to the level observed in commercial-purity material, while the high glide capacity of zone-refined beryllium was retained. Silicon additions resulted in no significant changes in deformation behavior. Iron and silicon added in combination appear to produce effects on properties of the type which may be attributed to precipitation reactions. (auth)

24135 (NMI-2812) PROGRESS ON THE STUDY OF THE URANIUM–ALUMINUM–IRON CONSTITUTION DIAGRAM FOR THE PERIOD JANUARY 1 THROUGH MARCH 31, 1964. R. B. Russell (Nuclear Metals. Div. of Textron Inc., West Concord, Mass.). Apr. 17, 1964. Contract AT(40-1)-3022. 24p.

Progress is reported of a research program on determining the U–Al–Fe constitution diagram up to ~1000 ppm each of Al and Fe. Substantial progress in the determination of the U–Al and U–Fe binary systems is made. Techniques used for these studies include optical, electron, and x-ray metallography; electron microanalysis; and electrical resistance-ratio measurements. (N.W.R.)

24136 (NP-13909) VLIYANIE NAPRYAZHENIYA I TEMPERATURY NA POLZUCHEST' NIKELYA, PREDVARITEL'NO DEFORMIROVANNOGO PRI 4.2°K. (Influence of Stress and Temperature on the Creep Rate of Nickel After Prior Deformation at 4.2°K). V. M. Azhazha, I. A. Gindin and Ya. D. Starodubov (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1963. 15p.

An analysis of the influence of stress and temperature on the creep rate of deformed nickel at 4.2°K showed an exponential relation. The effectiveness of low temperature treatment improves with diminishing stress and temperature. The activation energy of creep in nickel previously deformed at 4.2°K was determined, and structural changes produced by creep were studied. (tr-auth)

24137 (NP-13944) ELECTRICAL PROPERTIES OF SOME TRANSITION-METAL CARBIDES AND NITRIDES. Technical Report No. C-21. John Piper (Union Carbide Corp. Research Inst., Tarrytown, N. Y.). Apr. 1964. Contract DA-30-069-ORD-2787. 28p.

The Hall effect was studied as a function of temperature, electrical resistivity, and superconductivity of the face-centered cubic carbides and nitrides of the IVth and Vth group transition metals. The results were interpreted in terms of a rigid band model. The data indicated that when the total electron concentration is increased, as in the solid-solution series ZrC–NbC–NbN, additional electrons enter an energy band, which is nearly empty for ZrC. Superconducting critical temperatures and published magnetic susceptibility measurements suggest that the band over a large part of its span has an effective mass ~5m, where m is the free electron mass. Optical measurements indicated the presence of a band with a large density of states about 2.5 ev from the Fermi levels of Vth group carbides and IVth group nitrides. The large temperature dependence of the Hall coefficient of relatively pure TiC and ZrC was taken to imply that a second band contributes to electron transport in these compounds. The decrease in temperature dependence with nitrogen-doping suggested that the overlap of bands is ~0.1 ev. Isoelectronic compounds (e.g., NbC and ZrN) and also compounds with different metals of the same group (e.g., TiC, ZrC, and HfC) showed a considerable similarity in their electronic properties. It appears, therefore, that the form of the energy bands in these compounds is not highly sensitive to core potential. (auth)

24138 (PWA-2206(Vol.I)) DETERMINATION OF THE EMISSIVITY OF MATERIALS. Interim Final Report, July 1, 1959–December 31, 1962. W. H. Askwyth, R. J. Yahes, R. D. House, and G. Mikk (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). Contract NASw-104. 277p.

The thermal emittance of candidate materials for use in space radiators was measured in high vacuum. Measurement techniques were developed and facilities were constructed which permitted the accurate determination of spectral normal and total hemispherical emittance of materials at elevated temperatures. As a result of the experience gained during the program, the equipment has been modified and refined to permit more rapid and precise emittance data collection. Several methods of applying high-emittance coatings have been investigated. Of these, the two most successful methods were thermal spraying and aluminum–phosphate bonding. These two methods permitted the successful application of a variety of coatings to several substrate materials including molybdenum, AISI-310 stainless steel, and columbium-1 per cent zirconium. Both total hemispherical and spectral normal emittance measurements were made at temperatures ranging from 200 to 3100°F, at pressures as low as 4×10^{-8} mm Hg. Emittance changes resulting from exposure to elevated temperatures for periods up to 900 hours were determined for the more promising materials. In addition, the stability and adherence of three coating materials were determined for periods extending over 10,000 hours at a temperature of 700°F and a pressure of 10^{-7} mm Hg. These three materials were tested on SNAP-8 or Sunflower I tube-half fin radiator sections. Total hemispherical emittance was determined by comparing the electrical power dissipation per unit area in a heated strip or tube with the theoretical emissive power of a black body operating at the specimen temperature. Spectral normal emittance was determined by comparing the intensity of spectral normal emittance was determined by comparing the intensity of spectral normal radiation emitted from the surface of an electrically heated tubular specimen to the intensity of spectral radiation emitted by an integral source of black-body radiation. Intensity ratios were obtained for particular temperatures and wavelengths using a dual-beam spectrophotometer viewing the tubular specimen through a sodium chloride window in the vacuum chamber wall. Measurements were made over the wavelength range of 0.45 to 13.0 microns. Platinum–(platinum-10 per cent rhodium) and chromel–alumel thermocouples, as well as an optical pyrometer, were used for specimen temperature measurement. The materials tested on tube-half fin radiator sections were evaluated by visual observation and by monitoring temperatures at selected thermocouple locations. Thermal emittance data are included for the following types of materials: the refractory metals (tantalum, columbium, molybdenum, and tungsten); oxides of aluminum, copper, chromium, cobalt, niobium, nickel, manganese, silicon, tin, titanium, and zirconium; carbides of silicon, titanium, and vanadium; titanates of barium, calcium, iron, and strontium; and other ceramics. (auth)

24139 (PWA-2206(Vol.II)) DETERMINATION OF THE EMISSIVITY OF MATERIALS. Interim Final Report, July 1, 1959–December 31, 1962. (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). Contract NASw-104. 186p.

In this section of the report, results are tabulated. (T.F.H.)

24140 (PWA-2206(Vol.III)) DETERMINATION OF THE EMISSIVITY OF MATERIALS. Interim Final Report, July 1, 1959–December 31, 1962. (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). Contract NASw-104. 168p.

In this section of the report, the experimental apparatus is shown schematically and photographically, and experimental results are presented graphically. (T.F.H.)

24141 (RTD-TDR-63-4102) REFRACTORY CERAMICS OF INTEREST IN AEROSPACE STRUCTURAL APPLICATIONS—A MATERIALS SELECTION HANDBOOK. J. R. Hague, J. F. Lynch, A. Rudnick, F. C. Holden, and W. H. Duckworth (Battelle Memorial Inst., Columbus, Ohio). July 15, 1963. Contract AF33(657)-8326. 408p. (AD-423400)

Refractory-ceramic property data of interest to the designer of aerospace devices are presented. The data are intended to be of value primarily in the preliminary selection of materials. The materials covered are nonmetallic inorganic crystalline materials with melting points above 2730°F (1500°C), including intermetallic compounds and excluding glass, carbon, and graphite. The data are from literature published prior to 1962. The data are presented first by property, under the headings density, melting or decomposition temperature, specific heat, thermal conductivity, thermal expansion, elastic modulus, and bend strength. Then, detailed properties of each of nearly 600 materials are presented according to nominal material composition. (560 references.) (auth)

24142 (TID-20617) SUPERCONDUCTING METASTABLE COMPOUNDS. Technical Report No. 25. H. L. Luo (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials), M. F. Merriam, and D. C. Hamilton (California. Univ., La Jolla). Apr. 1964. Contract AT(04-3)-221. 8p.

Four metastable phases, germanides and tellurides of gold and silver, were found to be superconducting. It was demonstrated again that metastable compounds may become superconducting. Superconducting metastable compounds of Bi with copper and various other metals were found previously by Alekseekii and coworkers. Superconductivity was found in at least one, and probably two new crystal structures. These are the primitive cubic structures, one atom/unit cell, ($AgTe_3$ and Au_3Te_5) and the complex undetermined phase of the Au–Ge system. It was concluded that any metallic phase compounded from non-transition metals is likely to superconduct with a temperature above 0.3°K if its nominal valence electron concentration exceeds 1.5/atom. (auth)

24143 (UCRL-7390) FERROMAGNETISM IN DILUTE SOLUTIONS OF IRON IN GOLD. R. J. Borg, Rex Booth, and C. E. Violet (California. Univ., Livermore. Lawrence Radiation Lab.). June 4, 1963. Contract W-7405-eng-48. 10p.

Mössbauer resonant spectra were measured with a constant velocity drive apparatus using Au–Fe absorber foils (0.84, 1.85, and 7.38 at. % Fe) in conjunction with a stainless steel source and using an Au–Fe source (10.2 at. % Fe) with a stainless steel absorber. Spectra were obtained at room temperature, and 80, 27.4, 20.5, 4.2, and 2.2°K using liquefied N_2, Ne, H_2, and He, respectively. Magnetic ordering was observed at sufficiently low temperatures with the appearance of the six-line magnetic hyperfine spectrum of ^{57}Fe and the complete disappearance of the paramagnetic resonance line. No splitting occurred at room or liquid N_2 temperatures. The transition was determined to be ferromagnetic, and splittings were obtained. The relation of Curie temperature to the saturation magnetization and composition was also studied. The data support long range ferromagnetic coupling, operating presumably through the conduction electrons. (D.C.W.)

24144 (UCRL-11188) INFLUENCE OF QUENCHING CONDITIONS ON VACANCY LOOPS IN ALUMINUM (thesis). Gobinda Das (California. Univ., Berkeley. Lawrence Radiation Lab.). Jan. 1964. Contract W-7405-eng-48. 52p.

Great differences in the substructure of quenched and aged 99.999% purity aluminum were caused by varying the thickness of specimens at the time of quenching even though all other important variables such as quenching temperature, aging temperature, time, and purity were kept constant. The thickness of the specimens was varied within the range 25 to 400 microns. All specimens were quenched from 543°C into water at 40°C and aged at 40°C for 5 min. The size of dislocation loops resulting from clustering of excess vacancies progressively increased and their density decreased with increasing thickness of the specimens. In the thinner specimens the loops were primarily faulted with Burgers vector (a/3)[111], while in the thicker specimens perfect (a/2)[110] loops predominated. For the 400 μ specimens nearly all loops were perfect and diamond shaped will all four sides lying on {111} planes. The habit plane of the diamond shaped loops was approximately {023}. The concentration of vacancies that was necessary to account for the size and density of loops was approximately independent of specimen thickness. (auth)

24145 (WADD-TR-61-72(Vol.XIV)) RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XIV. STUDY OF HIGH-TEMPERATURE TENSILE PROPERTIES OF ZTA GRADE GRAPHITE. R. M. Hale and W. M. Fassell, Jr. (Aeronutronic. Div. of Ford Motor Co., Newport Beach, Calif.). Jan. 1963. Contract AF33(616)-6915. 76p.

The short-time tensile properties of ZTA grade artificial graphite are described. These tensile properties were measured under conditions of various annealings, various load rates, various atmospheres, and argon pressure from 5 to 150 psig at temperatures ranging to 2760°C (5000°F). The tensile strength was found to be dependent upon grain orientation, load rate, prior degassing treatment, and on surrounding gas pressure. (auth)

24146 (WADD-TR-61-72(Vol.XVII)) RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XVII. RADIOGRAPHY OF CARBON AND GRAPHITE. Thomas C. Furnas, Jr. and M. R. Rosumny (Picker X-Ray Corp. Waite Mfg. Div., Inc., Cleveland). Mar. 1963. Contract AF33(616)-6915. 30p.

A study was made to establish optimum exposure conditions for radiographic detection of minimum size defects in thicknesses of graphite varying from four to sixteen inches. Through the use of grids and associated techniques, 0.5% sensitivity or better was attained on high density graphite as follows: 4 in. graphite, 0.5% sensitivity; 8 in. graphite, 0.4% sensitivity; 12 in. graphite, 0.35% sensitivity; and 16 in. graphite, sensitivity. Parameters and techniques were investigated, such as direct x-ray magnification, screens, films, developers, and position of defects. Use of the grid made the greatest contribution towards an increase in sensitivity. (auth)

24147 (WADD-TR-61-72(Vol.XVIII)) RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XVIII. HIGH-TEMPERATURE TENSILE CREEP OF GRAPHITE. E. J. Seldin (National Carbon Co. Research Lab., Parma, Ohio). July 1963. Contract AF33(616)-6915. 42p.

Tensile creep tests under conditions of constant load and constant temperature were performed on four different types of graphite. The temperature ranged from 2300 to 2900°C. Some of the data were fitted to creep equations and the temperature and stress dependence of the steady-state creep rates were investigated. For ATJ graphite, the creep rates yielded an activation energy of 124 kcal/mole and varied with the fourth power of the stress for specimens with two different grain orientations. The activation energy was found to be the same for all the other graphites tested. The creep was found to be greater in the direction "against the grain" than in the direction "with the grain," and differences in creep strain and creep rate for the two orientations were found to increase as the anisotropy of the graphite was increased. For one type of graphite, the creep of specimens oriented "with the grain," decreased as the density increased and was not sensitive to differences in the proportions of filler and binder carbon. (auth)

24148 (AEC-tr-6316(p.212-16)) STRUCTURE OF POLYMERS FORMED BY RADIATION-INDUCED RING CLEAVAGE. Seizo Okamura, Koichiro Hayashi, Yasuhisa Kitanishi, Haruhiko Watanabe, Masanobu Nishii, and Yoko Nakamura. (Translation)

The polymers prepared by radioinduced solid-state polymerization of trioxane, diketene, and β-propiolactone were found to possess oriented crystal structure, particularly if the monomer crystals used in the polymerization were large. X-ray diffraction pattern photographs are presented to illustrate this observation. (D.L.C.)

24149 (AEC-tr-6316(p.226-31)) SOME ELECTRICAL PROPERTIES OF HEAT-TREATED POLYACRYLONITRILE FORMED BY RADIATION-INDUCED POLYMERIZATION. Seizo Okamura, Koichiro Hayashi, and Kenji Odan. (Translation)

Attempts were made to prepare semiconducting polyacrylonitrile by heat treatment of the product made by radioinduced polymerization. Electrical resistivity measurements were made using copper block and silver paste electrodes. The effects of heating time and temperature were studied. Thermoelectric measurements were also made. (D.L.C.)

24150 (EURAEC-538) RESULTS OF THE WORK CARRIED OUT FROM OCTOBER 1, 1962 TO DECEMBER 31, 1962. Quarterly Report No. 3. (Compagnie Pechiney, Paris). Jan. 31, 1963. Work performed under United States–Euratom Joint Research and Development Program. Contract 067-62-4/RDF. 114p. (A translation)

Zirconium, nickel-zirconium alloys, and vanadium-zirconium alloys are evaluated with respect to the effects of annealing, quenching, and tempering on the phases and mechanical properties and the effects of 400°C steam on the properties of the heat treated alloys. (N.W.R.)

24151 (EURAEC-986) NEW STRUCTURAL PROPERTIES OF STAINLESS STEELS PREPARED FROM METALS PURIFIED BY THE ZONE-MELTING TECHNIQUE. J. Montuelle and G. Chaudron (European Atomic Energy Community). 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 085-62-7/RDF. 5p. (EUR-1586.f). (A translation).

The preparation of 18-8 and 18-10 stainless steels from high-purity metals makes it possible to obtain steels having structures which vary with the heat-treatments applied. The martensitic transformation temperature of these alloys was determined; it depends on the high purity of the constituent metals. It was found to be possible to produce an 18-10 steel which has a two-phase austenitic-martensitic structure. On the basis of this alloy, new research is now in progress concerning its suitability for passivation. (auth)

24152 (EURAEC-1001) STUDY OF THE VARIATION OF TRANSFORMATION POINTS. INFLUENCE OF ALLOY AND REFINING ELEMENTS ON THE BEGINNING OF GAMMA-ALPHA TRANSFORMATION. Special Report No. 20, October 1–December 31, 1963. Usines Schneider (Societe Anonyme des Forges et Ateliers du Creusot, Le Creusot, France). Work Performed under United States–Euratom Joint Research and Development Program. Contract 073-61-12/RDF. 17p. (A translation)

A high-tensile-strength, low-alloy steel (1.1% Mn, 1% Ni, less than 1% of any other additive) is considered. The effects of addition of various elements (Si, Mn, Ni, Cr, Mo, C, Al, Ti, V, Nb, Ta, and Zr) on the transformation temperatures of this steel are measured. The first five of these additive elements are studied in amounts up to 5%, and the last seven are studied in amounts up to 0.5%. (T.F.H.)

24153 (EURAEC-1002) HYDROGEN EMBRITTLEMENT TESTS CARRIED OUT ON HIGH YIELD STRENGTH WELDABLE STEEL. Special Report No. 19, April 1–June 30, 1963. Usines Schneider (Societe Anonyme des Forges et Ateliers du Creusot, Le Creusot, France). Work Performed under United States–Euratom Joint Research and Development Program. Contract 073-61-12/RDF. 17p. (A translation).

Hydrogen embrittlement of this steel is normal, taking into account the quenched state of the steel. In order to enable the castings to be classified, we have determined two standard parameters, denoted Fc% and $[Fc\%/\Delta H_2]$. It is logical to think that following the introduction of hydrogen into the steel, the most valid classification criterion corresponds to that which leads to least embrittlement. We shall therefore take into consideration the relative embrittling effect Fc%. In this case, the results of our tests enable two groups to be distinguished: one of low embrittlement (titanium-, niobium-, or aluminum-alloyed castings); and the other of normal embrittlement, identical to the reference casting (vanadium-, nickel-, molybdenum-, or chromium-alloyed castings). These conclusions should be graded somewhat, taking into account the fairly high amount of scatter observed in the results. We therefore conclude that the average values of the embrittling effect obtained on aluminum, titanium, and niobium alloy castings does in fact correspond to a lower embrittlement. The latter is, however, little different from normal embrittlement. (auth)

24154 (RSIC-174) AGE-HARDENING. H. Boehm. Translated from Aluminium, 39: 753-9(1963). 18p.

The changes in resistance to deformation taking place with the decomposition of supersaturated crystalline solid solutions (age-hardening) are discussed. The various decomposition states that may occur are described. Some of the most important age-hardening theories are outlined and divided into two groups, depending on the behavior of the particles formed on decomposition. The question as to which theory is best capable of describing at stages of age hardening was considered. Some possibilities of further increases in strength on age-hardening are examined. (M.C.G.)

24155 THE MAGNETIC SUSCEPTIBILITY OF SOME CARBIDES OF URANIUM AND THORIUM. L. F. Bates and P. B. Unstead (Univ. of Nottingham, Eng.). Brit. J. Appl. Phys., 15: 543-9(May 1964).

The magnetic susceptibilities of the monocarbides and dicarbides of both thorium and uranium were measured at room temperature, and the temperature variation of susceptibility was also determined in the range 90–1100°K for both thorium and uranium carbides. The susceptibilities of uranium carbide-rich, uranium carbide–thorium carbide compounds were also measured in the same temperature range for specimens of nominal composition 1, 3, 8, 15, and 20% thorium carbide by weight. All the compounds show little variation of susceptibility in the range investigated. The susceptibility of each of the mixed carbides and uranium carbide is independent of temperature in the low temperature region. The slight curvature observed in this region for thorium carbide and thorium dicarbide is attributed to the presence of ferromagnetic impurity; the measurements do not fit a Curie–Weiss law. The variation of susceptibility may be explicable in terms of a band model, but at present the data are not sufficiently extensive. (auth)

24156 CRYSTAL STRUCTURE OF THE COMPOUND $EuGe_2$. E. I. Hladyshevskii. Dopovidi Akad. Nauk Ukr. RSR, No. 2, 209-12(1964). (In Ukrainian)

The germanium-richest compound of Eu with Ge, $EuGe_2$, has a structure of a new type (space group P3ml—D_{3d}^3, 1 Eu in 1(a), 2 Ge in 2(d) with z = 0.405 ± 0.005, a = 4.102 ± 0.003 Å, c = 4.995 ± 0.003 Å, c/a = 1.218), related to the AlB_2 type and formally analogous to the CdI_2 and $CeCd_2$ types. (auth)

24157 CRYSTAL STRUCTURES OF COMPOUNDS OF SCANDIUM WITH SOME TRANSITION METALS. P. I. Kripyakevich, V. S. Protasov, and Yu. B. Kuz'ma. Dopovidi Akad. Nauk Ukr. RSR, No. 2, 212-15(1964). (In Ukrainian)

The roentgenostructural method was used to study some alloys of scandium with manganese, cobalt, and copper. The existence was found and the structure determined for the compounds; $ScMn_2$ (type $MgZn_2$, a = 5.03, c = 8.19 Å, c/a = 1.63); $ScCo_2$ (type $MgCu_2$, a = 6.89 Å); ScCo (type CsCl, a = 3.16 Å) and ScCu (type CsCl, a = 3.24 Å). (auth)

24158 PROPERTIES OF NIOBIUM-BASE ALLOYS. R. A. Ul'yanov and N. D. Tarasov (Khar'kov Military-Engineering School). Fiz. Metal. i Metalloved., 17: 223-8(Feb. 1964). (In Russian)

Investigations were made of the regularities in changes of crystalline lattice parameters, hardness, and specific electric conductivity of Nb alloyed with W, Ta, Mo, Cr, Re, Pd, Ti, Zr, Ir, B, Si, and La. Specific electric conductivity of Nb alloys was examined as a function of temperature from 195 to 1750°C. (R.V.J.)

24159 EFFECTS OF MOLYBDENUM ON PHYSICAL ABNORMALITIES IN HARDENING INVAR-TYPE ALLOYS. S. I. Doroshek (Inst. of Ferrous Metals, Academy of Sciences, USSR). Fiz. Metal. i Metalloved., 17: 243-51(Feb. 1964). (In Russian)

The regular changes taking place in magnetic, elastic, electric, and strength properties of Invars alloyed with molybdenum during hardening are discussed. It is shown that Mo effects the physical abnormalities and also effects their properties during tempering. (tr-auth)

24160 MEASUREMENTS OF THE ENERGY OF FORMATION AND CONCENTRATION OF VACANCIES IN IRON–MOLYBDENUM ALLOYS. A. P. Mokrov (Tula Mechanical Inst., USSR). Fiz. Metal. i Metalloved., 17: 285-7(Feb. 1964). (In Russian)

Measurements of the formation and concentration of vacancies in Mo–Fe alloys showed that the concentration of vacancies grows exponentially with temperature at fixed temperatures, the formation energy increases. The concentration of vacancies is reduced with increased Mo, exhibiting a better bond in the iron due to the presence of molybdenum. Data on electric conductivity of various alloys as a function of temperature are tabulated. (R.V.J.)

24161 EFFECTS OF ALLOYING ELEMENTS ON STRENGTHENING OF IRON–NICKEL MARTENSITES DURING HEATING. M. D. Perkas and V. I. Snitsar (Inst. of Metallography and Metal Physics, Academy of Sciences, USSR). Fiz. Metal. i Metalloved., 17: 400-7(Mar. 1964). (In Russian)

Alloying effects of Ti, Al, Mn, Nb, Zr, and Mo on the annealing process in iron–nickel martensite were studied. Additions of Ti produced the strongest martensite. The relation between the initial structure and aging was determined, and the modulus of elasticity after heating to 700°C was found. (R.V.J.)

24162 ROENTGENOGRAPHIC STUDIES OF HIGH-TEMPERATURE PHASE TRANSITIONS IN $NaNbO_3$–$NaTaO_3$ SYSTEM. I. G. Ismailzade (Mamedaliev Inst. of Petroleum Chemical Processes, Academy of Sciences, Azerbaidzhan SSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 675-80(Apr. 1964). (In Russian)

Dielectric, optic, and structural studies indicated that sodium niobates ($NaNbO_3$) are antiseignettoelectrics at room temperature. According to previous studies the phase transformations in $NaNbO_3$ take place at 360, 470, 518, and 638°C. A fifth transition at 430°C was found by Zhdanov while the author has found a sixth transition at 570°C. X-ray studies were made of the nature of phase transitions in $NaNbO_3$ and $NaTaO_3$ and of the simultaneous effects of Nb and Ta ions on lattice symmetry. Phase diagrams of $Na(Nb_x,Ta_{1-x})O_3$ as a function of temperature showed that in all solid solutions the high temperature transitions correspond to transitions in $NaNbO_3$ (~ to 52.5 mole % $NaTaO_3$) or $NaTaO_3$ (over 52.5 mole % $NaTaO_3$). (R.V.J.)

24163 BeO PHASE TRANSFORMATION. J. B. Conway and R. A. Hein (General Electric Co., Cincinnati). Nucleonics, 22: No. 6, 71(June 1964).

BeO of 99.9% purity, with a grain size of 76 microns, is heated from 1800 to 2200°C. The thermal-expansivity curve is found to have an abrupt change in slope at 2100 ± 10°C. Enthalpy measurements by the drop technique strengthen the hypothesis that a phase transformation occurs at 2100 ± 10°C, with a heat of transformation of 54 ± 4 cal/g. (T.F.H.)

24164 A POLARIZED NEUTRON INVESTIGATION OF THE Fe_3Si ALLOY. A. Paoletti (CNEN, Rome) and L. Passari. Nuovo Cimento (10), 32: 25-32(Apr. 1, 1964).

The magnetic moment of iron atoms in the ordered alloy Fe_3Si has been investigated by polarized-neutron analysis. The magnetic moment of iron depends upon the relative population of the surrounding atoms like it has been already found in Fe_3Al. However the moment of iron atoms with Si as nearest neighbours is lower than the moment of the corresponding iron atoms in Fe_3Al. This result is related to the different number of 3p electrons in Si in respect to Al. (auth)

24165 HYDROGEN AFFINITY OF B.C.C. MOLYBDENUM–RHENIUM ALLOYS. D. W. Jones (Univ. of Birmingham, Eng.). Phil. Mag. (8), 9: 709-11(Apr. 1964).

Measurements were made of the heat of solution of a small quantity of hydrogen in molybdenum–rehnium alloys for electron/atom ratios between 6.0 and 6.4. Alloys containing less than 40% rhenium, the limit of the bcc phase in this system, were used. Hydrogen solubility and superconductivity are discussed. (M.J.T.)

24166 NEUTRON DIFFRACTION INVESTIGATION OF THE ANTIFERROMAGNETIC-FERROMAGNETIC TRANSFORMATION IN THE FeRh ALLOY. E. Kren, L. Pal, and P. Szabo (Central Research Inst. for Physics, Budapest). Phys. Letters, 9: 297-8(May 1, 1964).

The temperature dependence of the peak intensities of the (111) antiferromagnetic super-reflection and the (220) nuclear plus ferromagnetic reflection were measured on chemically synthesized powdered α'–FeRh specimens of equiatomic concentration to study the process of magnetic transformation. (R.E.U.)

24167 ION ENTRAINMENT BY ELECTRONS IN METALS. V. B. Fiks (Inst. of Semiconductors, Leningrad). Phys. Letters, 9: 299-300(May 1, 1964).

The mechanisms of momentum transmission for scattered electrons to impurity ions of atoms are discussed. (R.E.U.)

24168 LATTICE VIBRATIONAL SPECTRUM OF BERYLLIUM, MAGNESIUM, AND ZINC. James A. Young and Juan U. Koppel (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Rev., 134: A1476-9 (June 15, 1964). (GA-4879)

The lattice vibrational spectra of Be, Mg, and Zn were obtained using the root sampling method. The force constants used in the calculations were those determined from measurements of the dispersion relations by slow neutron-scattering techniques. Calculations of the specific heat of each metal show good agreement with measured values. (auth)

24169 MAGNETIC MOMENTS AND UNPAIRED SPIN DENSITIES IN THE Fe–Rh ALLOYS. G. Shirane (Brookhaven National Lab., Upton, N. Y.), R. Nathans, and C. W. Chen. Phys. Rev., 134: A1547-53(June 15, 1964). (BNL-7732)

The distribution of magnetic moments in the Fe–Rh system was investigated by the neutron diffraction technique in the composition range between 35 and 50 at. % Rh. These alloys have chemical order of CsCl type; the body-corner positions are occupied by FeI atoms and the body centers by Rh and FeII atoms. The magnetic moments in ferromagnetic alloys containing 35, 40, and 48% Rh are $\mu_{\mathrm{FeI}} = 3.1\ \mu_B$, $\mu_{\mathrm{FeII}} = 2.5\ \mu_B$, and $\mu_{\mathrm{Rh}} = 1.0\ \mu_B$ at 25°C. The moment of the FeI atom in the 50% Rh alloy, which is antiferromagnetic at room temperature, increases to 3.3 μ_B. A detailed study of the unpaired spin density distribution in the 48% Rh alloy was made by the polarized beam technique. While the FeI atom has a nearly spherical density distribution, that of the Rh atom shows a strong tendency toward e_0 symmetry. The coherent nuclear scattering amplitude of Rh was determined to be $0.585 \pm 0.005 \times 10^{-12}$ cm. (auth)

24170 MANY-BODY THEORY OF LOCALIZED d STATES IN METALS. II. PAIR OF IMPURITIES. P. Gottlieb (Hughes Research Labs., Malibu, Calif. and Univ. of California, La Jolla) and H. Suhl. Phys. Rev., 134: A1586-92(June 15, 1964).

A previous rotationally invariant perturbation treatment of localized d states is extended to the case of neighboring sites interacting via direct d-d exchange and indirect s-d scattering. It is found that the parallel alignment of two localized moments is never the ground state of the pair. For certain values of the unperturbed d-state energy (depending upon the exchange interactions) only one of the sites will be occupied by the d electron so the pair can have a net moment. If the conditions are such that both sites are occupied by d electrons, these electrons must be aligned antiparallel so there is only a small net moment due to scattering to and from the band states. (auth)

24171 FURTHER RESULTS ON THE FERMI SURFACE OF BERYLLIUM. T. L. Loucks (North American Aviation, Tulsa, Okla.). Phys. Rev., 134: A1618-20(June 15, 1964).

Following the methods presented earlier, the conduction eigenvalues for beryllium at the equivalent of over 80,000 points in the first Brillouin zone (all in the immediate vicinity of the Fermi surface) were calculated. The constant energy surfaces were constructed for several values of the energy near the Fermi energy. The hole and electron volumes were calculated for each case, and the Fermi energy was determined by the requirement that the two volumes be equal. This is the first time that this well-known result was actually used to determine the Fermi energy in a band calculation. The corresponding Fermi surface was defined by about ten cross sections perpendicular to the [0001] direction. The agreement between these results and experiment is generally good and slightly improved over previous results. (auth)

24172 ANTIFERROMAGNETISM OF PRASEODYMIUM. J. W. Cable, R. M. Moon, W. C. Koehler, and E. O. Wollan (Oak Ridge National Lab., Tenn.). Phys. Rev. Letters, 12: 553-5(May 18, 1964).

Observations of neutron diffraction on metallic praseodymium which show the existence of antiferromagnetic order are reported. This observed antiferromagnetic order probably accounts for the nuclear hyperfine contribution to the low-temperature specific heat. (M.J.T.)

24173 THERMAL EXPANSION OF TUNGSTEN AND MOLYBDENUM DISILICIDES. N. N. Matyushenko (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 1, 20-2(Jan.-Feb. 1964). (In Russian)

A roentgenographic method was used to measure the mean coefficient of linear expansion of molybdenum disilicide over a temperature range of 13–613°C, a value of $9.2 \pm 0.6 \cdot 10^{-6}$/degree being obtained. The mean coefficient of linear expansion of tungsten disilicide is less than that of molybdenum disilicide, the difference comprising about 3 pC. (auth)

24174 SHEAR MODULI OF THE SILICIDES OF SOME TRANSITION METALS. V. S. Neshpor and S. S. Ordanyan (Leningrad Technological Inst.). Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 1, 23-8(Jan.-Feb. 1964). (In Russian)

The shear moduli of a number of silicides of transition metals and of molybdenum germanide were studied experimentally. Data were obtained for the first time on the velocity of sound and the shear modulus for the silicides of various compositions, and the results obtained are discussed. The covalent bonds between silicon atoms in higher silicides are shown to be predominant. (auth)

24175 STRUCTURE OF TWO-PHASE METAL-POWDER SOLID ALLOYS. V. A. Ivensen and O. N. Eiduk (All Union Inst. of Hard Alloys, Moscow). Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 1, 56-64(Jan.-Feb. 1964). (In Russian)

Peculiarities of the structure of two-phase alloys WC-Co are discussed and the present state of the problem of the existence of a so-called carbide skeleton in alloys, i.e., continuous bond between the grains of the carbide phase was surveyed. (auth)

24176 THE HIGH-TEMPERATURE ALLOTROPY OF SOME HEAVY RARE-EARTH METALS. A. E. Miller and A. H. Daane (Ames Lab., Ames, Iowa). Trans. AIME, 230: 568-72(Apr. 1964). (IS-674)

The high-temperature allotropy of some heavy rare-earth metals and their alloying behavior with magnesium in the 0 to 50 at. pct Mg region was studied by thermal, microscopic, and x-ray methods. Examination of a bcc phase retained upon quenching alloys of different magnesium content confirmed the existence of a bcc high-temperature allotrope in pure gadolinium, terbium, dysprosium, holmium, erbium, thulium, and lutetium. The lattice constants of the pure metals were determined from a Vegard's Law extrapolation and found to be 4.05, 4.02, 3.98, 3.96, 3.94, 3.92, and 3.90 ± 0.02 Å, respectively. In all of the systems studied, the high-temperature bcc phase decomposed eutectoidally, when slowly cooled, into a hexagonal rare earth-Mg solid solution and a simple-cubic peritectic AB-type compound. (auth)

24177 VAPOUR PRESSURE OF SOLID YTTRIUM. A. A. Kruglykh, V. S. Pavlov, and G. F. Tikhinskii (Inst. of Physics and Tech., Khar'kov). Ukr. Fiz. Zh., 9: 214-15 (Feb. 1964). (In Ukrainian)

The vapor pressure of yttrium was determined over the temperature range of 1100-1480°C by the method of evaporation from a cylindrical crucible. The results are expressed by the equation $\log P_{mm} = -(18500/T) + 7.580$. (auth)

24178 FERRO- AND ANTIFERROMAGNETISM OF RARE EARTHS. K. P. Belov, R. Z. Levitin, and S. A. Nikitin. Usp. Fiz. Nauk, 82: 449-98(Mar. 1964). (In Russian)

A review is given of the magnetic properties of rare earth ferromagnetics. Ferromagnetic rare earths of the yttrium subgroup (Gd, Tb, Dy, Ho, Er, and Tm) possess singular magnetic properties in comparison to iron ferromagnetics. In a certain temperature range five of the rare earth ferromagnetics (Gd, Dy, Er, Ho, and Tm) exhibit spiral or helical antiferromagnetic behavior. Most members of the cerium subgroup (Ce, Nd, Sm, and Eu) are antiferromagnetic at low temperatures. Helical magnetic structure, magnetic phase transitions, magnetoelastic properties, and electric and galvanometric properties were analyzed. 153 references are included. (R.V.J.)

24179 SUPERCONDUCTIVITY OF THE NOBLE METALS AND THEIR ALLOYS. Christoph Raub (Univ. of California, San Diego, La Jolla). Z. Metallk., 55: 195-9(Apr. 1964). (In German)

Only three of the noble metals are superconductors above 0.35°K, but it is likely that gold and platinum of highest purity become superconductors at lower temperatures (10^{-3}°K). None of the solid solutions of gold or silver, but several solid solutions of the platinum-metals are superconducting. Small additions of noble metals to superconducting elements of group V reduce their transition-temperature, in group V they increase T_c. Only a few superconducting silver- or gold-compounds are known. A survey of the superconducting compounds of the platinum metals with the transition and nontransition elements showed some general features: the highest transition temperatures occurred among the β-tungsten, A12 and δ-phases and with increasing metallic properties of the groups IV A, V A, and VI A of the periodic system, the concentration of the superconducting phases shifted to smaller platinum metal combinations. (auth)

24180 DIAGRAMMY SOSTOYANIYA METALLICHESKIKH SISTEM. OPUBLIKOVANIYE V 1960 GODU. VYPUSK VI. (Constitution Diagrams of Metallic Systems, Published in 1960. Volume VI). Z. M. Rogachevskaya. Moscow, Publishing House of All-Union Institute of Scientific and Technical Information, 1962. 175p.

Constitution diagrams for metal system and alloys, published during 1960, are presented. Descriptions are given of the preparation and characteristics of the systems. (R.V.J.)

24181 DIAGRAMMY SOSTOYANIYA METALLICHESKIKH SISTEM, OPUBLIKOVANNYE V 1961 GODU. VYPUSK VII. (Constitution Diagrams of Metal Systems, Published in 1961. Volume VII). Z. M. Rogachevskaya. Moscow, Publishing House of All-Union Institute of Scientific and Technical Information, 1963. 263p.

Constitution diagrams of metals and alloys, published during the year of 1961, are presented. Descriptions are given of the preparation of alloys and investigations of their phase characteristics. (R.V.J.)

24182 THERMAL CONDUCTIVITY OF SCANDIUM BETWEEN 5 AND 320°K. S. Arajs and R. V. Colvin (U. S. Steel Corp., Monroeville, Penna.). 10p. (CONF-405-23)

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

The thermal conductivity, λ, of scandium was measured as a function of temperature, T, between 5 and 320°K. The λ vs T curve exhibits a maximum ($\lambda = 0.139$ W cm^{-1}°K^{-1}) at about 35°K. It passes through a minimum at about 50°K, and then above 60°K gradually increases, reaching the value of 0.260 W cm^{-1}°K^{-1} at 320°K. The Lorenz function for scandium, calculated from the measured thermal conductivity and electrical resistivity data on the same sample, indicates that there is considerable heat transport by phonons. The behavior of λ, apart from the influence of the magnetic transformations in the rare earth metals, is quite similar to that observed in these elements. (auth)

24183 HEATS OF SOLUTION OF PRASEODYMIUM, NEODYMIUM AND SAMARIUM IN LIQUID TIN AT 750°K. R. F. Peluso (Martin Co., Denver, Colo.) and M. J. Pool. 15p. (CONF-405-24)

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

The partial molar heats of solution of praseodymium, neodymium, and samarium in liquid tin were determined by liquid metal solution calorimetry. A liquid tin solution calorimeter operating at 750°K was used. All samples were added to the molten tin from 273°K and the heat of solution at 750°K was calculated by subtracting the heat content relative to 273°K from the total measured heat effect. It was found that the partial molar heats of solution are large and exothermic for all of the rare earths studied. No compositional dependence of the partial molar heats of solution was found in the dilute concentration range investigated (0-2 at.% solute). Moreover, the values became less exothermic as the atomic number of rare earth increases. Specifically, the values for the partial molar heats of solution are: $\overline{\Delta H}_{750} = -70{,}000$ cal/g-atom ± 2500, $\overline{\Delta H}_{750} = -58{,}000$ cal/g-atom ± 2000, and $\overline{\Delta H}_{750} = -53{,}000$ cal/g-atom ± 2500 for Pr, Nd, and Sm, respectively. All of the measured values are of the order of the heats of formation of intermetallic compounds. It is postulated that the large negative heat effects are associated with strong atomic interactions of unlike atoms in the liquid state. (auth)

24184 INVESTIGATIONS OF THE STRUCTURE AND MAGNETIC BEHAVIOR OF PERITECTIC Pr—Fe AND Nd—Fe COMPOUNDS OF THE TYPE RFe_7 BY MEANS OF NEUTRON DIFFRACTION. H. Weik (Univ. of Cincinnati), P. Fischer, E. Stoll, and W. Haelg. 13p. (CONF-405-29)

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

Neutron diffraction experiments were performed on Fe—Nd and Fe—Pr compounds of the type RFe_7 in the temperature range 90 to about 500°K. The neutron scattering data revealed additional nuclear reflections besides those previously found by means of x-ray techniques. The fact that all reflections observed satisfy the rhombohedron condition strongly indicates that both substances crystallize in the symmetry class R, the space group probably being $R\bar{3}m$. The diffraction patterns below the magnetically determined Curie temperatures (280°K for $PrFe_7$, and 326°K for $NdFe_7$) showed no additional magnetic reflections, suggesting a ferromagnetic or simple, i.e., collinear ferrimagnetic spin coupling. The patterns above the Curie temperatures exhibited no signs of paramagnetism even at temperatures as high as about 200°K above the Curie temperatures. Instead, several additional weak reflections were found in this temperature range, indicating a transistion from ferromagnetic or simple ferrimagnetic to antiferromagnetic spin coupling at or near the magnetically measured Curie temperatures. (P.C.H.)

24185 RE-ENTRY BURNUP ENHANCEMENT OF HYDRIDED ZIRCONIUM URANIUM ALLOY FUEL. E. L. Foster, Jr. (Battelle Memorial Inst., Columbus, Ohio). 33p. (CONF-311-11)

From American Nuclear Society Aerospace Nuclear Safety National Topical Meeting, Albuquerque, N. Mex., Oct. 1963.

The feasibility of changing the properties of the ZrH—U fuel by use of certain additives in such a way that will enhance the atmospheric burnup upon re-entry from orbit was studied. The effects of additions to the fuel, particularly those that could produce smaller droplet sizes during its re-entry melting, were investigated by both analytical and experimental methods. Twenty-seven alloying elements were studied: Pb, Bi, Mg, Ce, Sn, Si, Al, Ba, Ca, Nb, Sr, Y, Tl, Zn, Mo, Th, Sb, Cu, Cr, Ni, V, W, Ta, Ti, N, O, and C. Some of the alloying additions caused significant changes in the properties and fabrication characteristics of the fuel (hardness, grain size, melting, casting, rolling, hydriding, and machining). Certain elemental additions improved properties while others caused a deterioration in properties. The majority of the alloys, however, were readily fabricable. Specimens of 12 different modifications of the reference fuel exhibited ablation losses about the same as the reference fuel. These modifications contained additions of V, W, Ta, Al, Bi, Sb, Sr, Si, Sn, Nb, O, N, and C. The typical products of the rocket-exhaust ablation tests were particles that ranged in size from less than 1 to 5000 μ. It was concluded that it is possible to change the ablation characteristics of the hydride fuel. (P.C.H.)

24186 HIGH FIELD MAGNETIZATION OF RARE EARTH METALS AND ALLOYS. Warren E. Henry (Lockheed Missiles and Space Co., Sunnyvale, Calif.). 25p. (CONF-405-28)

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

Studies on the high field magnetization of rare earth metals and alloys were carried out in order to help provide a better understanding of the origin of the apparent magnetic atomic constants, of exchange interactions as they relate to ferro-, antiferro, ferri-, and metamagnetism, and to obtain a better appreciation of the effect of structure and the crystalline electric field especially as it acts in conjunction with the spin-orbit interaction. Actual measurement of the saturation magnetization of the rare earth metals gave the theoretical values, using Hund's rule, in some of the cases, such as Gd and Ho, and the expected low moment for Sm. However, even in the case of Ho, the saturation moment was dependent upon the method of processing the metals. It implies an effect of the crystalline electric field. This explains lower than theoretical values (simple Hund's rule) of some of the rare earth metals that may crystallize in different ways with different handling. Results with rare earth alloys and compounds are also discussed. (P.C.H.)

Radiation Effects

Refer also to abstract 24937.

24187 (AERE-R-2935) GAS BUBBLE GROWTH ON HEATING IRRADIATED URANIUM. J. B. Rich and R. S. Barnes (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Dec. 1959. 12p.

Uranium irradiated to 0.15 and 0.3 to 0.4% burnup at less than 300°C was heated between 300 and 1000°C and examined metallographically. Because the bubbles decreased in number and increased in size as the temperature was raised it was concluded that xenon and krypton, which are already precipitated as small bubbles before heating, can be redistributed in uranium. This alters some of the concepts involved in the swelling process. (auth)

24188 (APEX-329) RADIATION DAMAGE TEST OF LITHIUM HYDRIDE CAST MATERIAL. David L. Henry (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 16, 1956. Contract AT(11-1)-171. 7p.

A radiation damage study on cast lithium hydride was conducted in the LITR. After a dosage of approximately 2×10^{18} nvt at 1000°F, there was no perceptible change in physical properties. (auth)

24189 (APEX-730) METALLIC WIRE FUEL ELEMENT MATERIALS IRRADIATIONS TEST SUMMARY. W. R. Yario (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Nov. 1961. Contracts AT(11-1)-171 and AF33(600)-38062. 24p.

Sample 3F69, a wire-type fuel element containing a 100% UO_2 core, operated successfully for 378 hours at 2000°F in the ANP-3 facility of the MTR until removal at the end of cycle 154 on April 10, 1961. All thermocouples operated satisfactorily for the duration of the test. The fission product release rates were very low throughout the test. Post-test examination revealed that the nichrome-clad 100% UO_2 core sample was in good condition and did not rupture nor suffer severe oxidation during testing. (auth)

24190 (GA-5037) EFFECT OF NEUTRON IRRADIATION ON MATERIALS SUBJECTED TO MULTIAXIAL STRESS DISTRIBUTIONS. Quarterly Progress Report, October 1, 1963–January 31, 1964. T. A. Trozera and P. W. Flynn (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Feb. 28, 1964. Contract AT (04-3)-167. 13p.

Studies are reported of the effects of radiation on tubes subjected to multiaxial stress distribution and the manner in which irradiating A-302B steel affects the use of a flow parameter to correlate uniaxial tensile data with other stress distributions. (auth)

24191 (HW-SA-3194) EFFECTS OF NEUTRON IRRADIATION ON THE FLOW AND FRACTURE BEHAVIOR OF ZIRCALOY-2. A. L. Bement, J. C. Tobin, and R. G. Hoagland (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 1, 1963. Contract AT(45-1)-1350. 40p. (CONF-512-3)

From American Society for Testing and Materials, 67th Annual Meeting, Chicago, June 1964.

The effects of cold work and neutron irradiation on the deformation and fracture behavior of Zircaloy-2 were studied. Both annealed and cold-worked specimens were given fast neutron exposures over the range 10^{19} to 10^{21} neutrons/cm^2 at irradiation temperatures of 60 and 280°C. Specimens were taken both from the transverse and rolling directions of sheet containing 0, 10, 20, 40, and 70% cold work. The preferred orientations imparted by cold rolling were characterized by x-ray diffraction. The effects of preferred orientation on tensile properties were modified by neutron irradiation. However, variations in the inhomogeneity of deformation with stress direction were as dominant after irradiation as before. Although modes of fracture and void formation in smooth tensile specimens were unchanged by irradiation, the deformation during necking in the transverse direction was more confined to shear zones. This greater confinement of necking deformation plus the decrease in strain hardenability accounted for a large decrease in fracture energy with irradiation. Data showing the effect of irradiation temperature on tensile properties and the effect of neutron exposure on notch strength are presented. At high neutron doses, damage accumulation with irradiation near 300°C was greater than at lower temperatures. Neutron irradiation alone to about 3×10^{20} neutrons/sq cm did not embrittle annealed Zircaloy-2 but could cause notch sensitivity in material containing sufficient cold work. Hydrogen pickup during exposure in an in-reactor loop was greater than in an ex-reactor loop and might contribute to embrittlement. (auth)

24192 (HW-SA-3221) THE COMBINED EFFECTS OF TEMPERATURE AND IRRADIATION ON THE MECHANICAL PROPERTIES OF AUSTENITIC STAINLESS STEELS. J. E. Irvin, A. L. Bement, and R. G. Hoagland (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 15, 1964. Contract AT(45-1)-1350. 31p. (CONF-512-1)

From American Society for Testing and Materials 67th Annual Meeting, Chicago, June 1964.

The effects of neutron irradiation and temperature on the mechanical properties of AISI 348 and 304 stainless steels were determined using smooth and notched tensile specimens containing different amounts of cold work. Smooth tensile specimens were irradiated at about 50, 290, and 750°C. Room temperature and 300°C tests on specimens in both the annealed and 25% cold worked conditions showed a marked reduction in ductility with increasing exposure and increasing test temperature. Damage accumulation as measured by changes in mechanical properties occurred more rapidly at the intermediate irradiation temperature. Control specimens exposed in an out-of-reactor loop at 282°C for times in excess of 5000 hours showed a significant change in mechanical properties. Notched tensile specimens of AISI 348 stainless steel in the annealed, 10, 20, and 40% cold worked conditions were irradiated about 290°C and tested at room temperature. The mode of fracture was ductile in nature throughout the range of cold work and neutron exposures studied. A transition from notch strengthening to a notch sensitive behavior was observed for specimens in the 20 and 40% cold work levels after an exposure of about 1.0×10^{20} neutrons per square centimeter (>1 Mev). The effects of cold work, temperature, and chemical composition on the metallurgical stability of these materials were examined using magnetic measurements and x-ray diffraction. The magnetic susceptibility of both materials containing up to 70% cold work was determined prior to irradiation. No measurable change was noted in the magnetic susceptibility of either the annealed or 25% cold worked materials, which were irradiated to exposures of 1.5×10^{21} neutrons per square centimeter (>1 Mev). Optical and electron microscopy studies on both materials revealed no changes in structure due to the combined effects of irradiation and temperature. (auth)

24193 (HW-SA-3436) IRRADIATION EFFECTS ON HIGH TEMPERATURE REACTOR STRUCTURAL METALS. T. T. Claudson and H. J. Pessl (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [1964]. Contract AT(45-1)-1350. 31p. (CONF-512-2)

From American Society for Testing and Materials 67th Annual Meeting, Chicago, June 1964.

In an investigation of the effects of radiation on nickel base alloys, it was determined that for those alloys irradiated at relatively low temperatures and tested at room temperature, little effect upon their mechanical properties could be found. However, for those alloys irradiated at high temperatures and tested at 700°C (1292°F), a rapid deterioration of properties occurred, especially in the ductility of the material. These effects were similar to those found in over-aging the materials. Other investigators found similar results though the deterioration of the ductility of the material was not so pronounced. In these investigations, tensile tests in the temperature range of 2 to 870°C on specimens of Hastelloy X irradiated at 540, 6 and 870°C showed a lowering of ductility values with increasing irradiation temperatures. Specimens irradiated at 650 and 870°C also showed a decrease in ductility with an increase in post-irradiation tensile test temperature. Subsequent reheat treatments of these specimens appeared to again increase the ductility. Variations in pre- and post-irradiation heat treatments appeared to be significant. The oxidation data presented illustrate the necessity for examining the structure of the material after exposure as well as the weight changes involved. This was especially true when the application was for thin sections of material as in the case of fuel claddings. While the temperatures used in these investigations were higher than found in most present reactors, they were not out of the range of application for this class of alloy and may correspond to temperatures in advanced reactor concepts. Further tests now being completed exposed the same group of alloys to the environment at 815 (1500°F) and 1040°C (1900°F). The refractory metal data show some very pronounced effects upon the strength and ductility properties of niobium and tantalum alloys. The drastic nature of these effects may be caused primarily by the condition of the material prior to irradiation. (auth)

24194 (NP-13930(p.116-17)) STREUUNG SUBTHERMISCHER NEUTRONEN AN GITTERFEHLERN. (Scattering of Subthermal Neutrons on Lattice Defects). K. Baierlein, J. Christ, W. Schilling, W. Schmatz, T. Springer, and K. Takumi (Munich. Technische Hochschule).

Subthermal neutrons were used for investigation of lattice defect order in reactor-irradiated substances and cold-formed metals. Irradiated copper and quartz and cold-formed copper were studied. (M.C.G.)

24195 (ORNL-TM-815) POSTIRRADIATION EVALUATION OF STAINLESS STEEL-CLAD PLATE-TYPE SPECIMENS CONTAINING 3 WT % ENRICHED BORON IN IRON. A. E. Richt, C. F. Leitten, Jr., and R. J. Beaver (Oak Ridge National Lab., Tenn.). June 1964. Contract W-7405-eng-26. 14p.

Plate-type stainless steel-clad specimens, containing 3 wt % B dispersed in iron, were irradiated in the Engineering Test Reactor at 180°F to 29% average burnup of the ^{10}B atoms. The boron in these samples was enriched to the 90% level in the ^{10}B isotope. Although miniaturized in length and width, the specimen thickness was identical with that of the first prototype neutron absorber placed in the SM-1 Reactor at Fort Belvoir, Virginia. Dimensional and metallographic examination of the irradiated specimens revealed that, in the range of 5 to 8% burnup of the ^{10}B atoms, the bonding between the neutron absorber and protective cladding began to deteriorate and swelling occurred. Increases in thickness as high as 30% were observed at the higher burnups. Postirradiation heat treatment at 570°F caused some additional swelling, indicating that swelling under SM-1 operating conditions would be more severe than observed after irradiation at 180°F. The early failures of the bond are attributed to localized burnup greater than 35% of the ^{10}B atoms in the region adjacent to the stainless steel cladding. Because of the burnup limitations, the continued use of this boron-iron combination as a serviceable neutron absorber for the SM-1 Reactor is not recommended. (auth)

24196 (PWAC-278) A PRELIMINARY INVESTIGATION OF THE EFFECTS OF IRRADIATION ON COLUMBIUM-0.6% ZIRCONIUM ALLOY. (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). June 22, 1959. Contract AT(11-1)-229. 22p.

Eighteen substandard size tensile specimens were fabricated from an ingot of vacuum arc melted niobium-0.6% zirconium alloy. Twelve of these tensile specimens were irradiated in the Materials Testing Reactor at the coolant water temperature. The remaining six specimens were retained and tested as controls for the irradiated specimens. Test results of this material showed radiation effects to increase strength properties 25 to 40% with an insignificant decrease in percent elongation. Annealing temperatures of 1400°F and above appeared to remove all of the radiation effects. Temperatures as low as 1600°F apparently removed some effects of cold working. The modulus of elasticity was determined experimentally to be $15.0 \times 10^6 \pm 1\%$ psi. (auth)

24197 (AEC-tr-6316(p.114-17)) STUDIES ON HIGH-TEMPERATURE IRRADIATION OF POLYMERS. NO. 4. HIGH-TEMPERATURE IRRADIATION OF POLYVINYL ALCOHOL. Progress Report. Ichiro Sakurada, Norio Okada, and Hitoshi Abe. (Translation)

Results are reported of the effects of high-temperature irradiation on the gel formation and viscosity of PVA. The irradiations were conducted at 50°C and 70 to 170°C. (D.L.C.)

24198 (AEC-tr-6316(p.118-20)) STUDIES ON HIGH-TEMPERATURE IRRADIATION OF POLYMERS. NO. 5. RESULT OF POST HEATING OF POLYVINYL ALCOHOL IRRADIATED AT ROOM TEMPERATURE. Ichiro Sakurada, Norio Okada, and Hitoshi Abe. (Translation)

A study was made of the effects of room temperature irradiation followed by heating above the second transition temperature on the gel formation in PVA. When the dose is more than 8 Mr, the gel content exceeded 90% after a heating of 150 hr, and this effect reached saturation at >50 Mr. The structure changes and radicals were studied by infrared analysis and ESR measurements. (D.L.C.)

24199 (AEC-tr-6316(p.359-67)) ON THE EFFECT OF THE ADDITION OF PIGMENTS TO THE RADIATION BEHAVIOR OF POLYMERS. Isamu Nitta, Yasuji Odan, and Shunichi Onishi. (Translation)

The effects of inorganic oxides and other fillers on the radiation behavior of polymers were studied. The effects on the free radical production were determined for polymethyl methacrylate and polystyrene. The effects on the radioinduced dissociation and on the changes in the mechanical properties were studied using polymethyl methacrylate. The results show that the additives increase the free radical production, decrease the ductility after irradiation, and in general enhance the radiation effects. (D.L.C.)

24200 (ANL-Trans-19) STRENGTHENING OF NEUTRON-IRRADIATED SINGLE CRYSTALS OF COPPER. III. INTERPRETATION AND EVALUATION OF SOME CHARACTERISTIC VALUES OF STRENGTHENING. Armin Ruckwied and Joerg Diehl (Max-Planck-Institut fur Metallforschung, Stuttgart). Translated by Lydia Venters (Argonne National Lab., Ill.), [1963]. 25p.

To be published in Z. Metallk., [1964].

Stress-strain curves of neutron irradiated single crystals of copper were divided into types depending on irradiation dose, deformation temperature, and deformation rate. The individual characteristic values are described as actual phenomena with avoidance of all interpretation, explanation and evaluation depending on external experimental parameters. Distinguishing characteristics were obtained that verified the classification of the curves. Familiar theoretical initial assumptions developed in part for the irradiated and in part for the nonirradiated crystals were drawn to interpret the data of measurements. The theory was compared with experiment. (P.C.H.)

24201 (ANL-Trans-22) THE DISLOCATIONS OF ALPHA URANIUM. J. Leteurtre (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Fontenay-aux-Roses). Translated by D. G. Westlake (Argonne National Lab., Ill.), from Report No. 372, Mar. 1964. 27p.

Theoretical aspects of dislocations in α uranium from which a model was constructed are discussed. The nature of twin dislocations was also studied. A mechanism for the nucleating of twins, based on the dipoles frequently observed in α uranium, is proposed. It was verified that the accumulation of point defects, introduced by irradiation, generates dislocation loops with vectors (100) and $^1/_2$ <110>, which was part of a previous hypothesis for explaining growth. Results observed in micrographs are discussed. (P.C.H.)

24202 (GA-tr-5174) THE KINETICS OF OXIDATION BY A LIQUID SOLUTION OF UNIRRADIATED AND IRRADIATED NUCLEAR GRAPHITES. M. Oberlin (France. Institut National de Recherche Chemique Appliquée, Paris); J. Rappeneau, and M. Yvars (France. Commissariat a l'Energie Atomique. Centre d'Études Nucleaires, Saclay). Translated by J. L. White (General Atomic Div., General Dynamics Corp., San Diego, Calif.), from a paper presented at the Sixth Conference on Carbon, Pittsburgh, June 17-21, 1963. 27p.

The kinetics of oxidation of graphite in a sulfuric-chromic acid solution are strongly influenced by structural defects. An experimental method presented previously affords the possibility of identifying and measuring the various structural components. By applying this method to nuclear graphites, the presence of ungraphitized residues from binders or impregnants can be identified. Various types of nuclear graphite were studied, and the influence of successive impregnations with pitch was demonstrated. The method also provides data in studies of the heat treatment of baked products. Graphites irradiated to doses of the order of 1×10^{20} nvt and at temperatures between 50 and 250°C were examined. The method of oxidation by liquid solution proved to be very sensitive to the damage resulting from neutron irradiation; the rate of oxidation decreased markedly for relatively small radiation doses for the graphites studied. (auth)

24203 DISCHARGE FIGURES IN DIELECTRICS BY ELECTRON IRRADIATION. [PART] II. Junichiro Furuta, Eiichi Hiraoka, Shinichi Okamoto, Tokuhiro Ohnishi, and Yukio Tsujii. Ann. Rept. Radiation Center Osaka Prefect., 4: 77-82(1963).

Results concern the decay of charge, change of electric conductivity, and their after effects in glass insulators, which was irradiated by 15 Mev Linac and ^{60}Co gamma rays. The discharge figures became small gradually with the lapse of time after irradiation. This seemed to be caused by the leak of stored charge inside the samples. The electric conductivity of the insulator became better generally with irradiation doses, so the charge escaped mainly from the direction of irradiation. The electric conductivity of poly(methyl methacrylate) (PMMA) and polyethylene (PE) of 1.5-mm thickness were measured to make clear the mode of strange decays in the discharge experiments. Variations of the gradient of decays and also deviations from linear line in log-log scale were found. (P.C.H.)

24204 TEXTURE AND IRRADIATION-INDUCED GROWTH IN TRAVERSE-QUENCHED DILUTE Al–Fe–U ALLOYS. J. H. Gittus (United Kingdom Atomic Energy Authority, Springfields, Eng.). J. Brit. Nucl. Energy Soc., 3: 106-10(Apr. 1964).

Cavitational failure of the cladding in some of the earlier magnox-clad uranium fuel elements irradiated in Calder Hall type reactors was tentatively ascribed to irradiation-induced anisotropic growth of the fuel-rods. It now appears that this growth is associated with preferred orientation, produced by the heat-treatment adopted for the purpose of grain refinement. The texture was found to vary with the iron and aluminum contents of the fuel-rod, apparently (at least in the case of iron) because of effects of composition upon the transformation-front and upon the orientation of the transformed product relative to the transformation front. It was found that fuel-rods of relatively high iron and low aluminum contents produce the fewest cavitational failures. (auth)

24205 γ-RADIATION-INDUCED CHANGES IN THE STRUCTURE OF POLYETHYLENES. W. C. Sears (Univ. of Georgia, Athens). J. Polymer Sci., Pt. A, 2: 2455-69 (May 1964).

The concentrations of *trans*-vinylene groups in Marlex 50 and DYNH polyethylenes were determined from infrared spectra before and after irradiation of polyethylene films with γ rays. Values fo G for *trans*-vinylene growth were found to be 2.2 and 1.7 for Marlex 50 and DYNH polyethylenes, respectively. *trans*-Vinylene decay constants and concentrations at infinite dose were evaluated. The growth and decay of vinyl unsaturation and growth of vinylidene unsaturation in Marlex 50 are discussed. Assignment was made of polyethylene bands at 889 and 894 cm^{-1} to vinylidene unsaturation and to ethyl groups in saturated paraffins, respectively, on the basis of different means of saturating the double bond. The frequencies of new bands produced in Marlex 50 and DYNH by irradiation were correlated with those of substituted cyclopentanes and cyclohexanes. It was concluded that a complex mixture of these cyclic compounds was formed in Marlex 50 and DYNH. There appeared to be no correlation between the frequencies of the radioinduced bands and frequencies known to be characteristic of conjugated double bonds. (auth)

24206 PRE-PRECIPITATION RATE IN Al–10% Zn ALLOY NEUTRON-IRRADIATED AT 78°K. S. Ceresara (Istituto Sperimentale dei Metali Leggeri, Novara, Italy), T. Federighi, and F. Pieragostini. Phil. Mag. (8), 9: 623-33(Apr. 1964).

The effect of a neutron irradiation at 78°K on the rate of preprecipitation in Al–10% Zn alloy was investigated by means of resistivity measurements. Although interstitial-type defects do not produce clustering of Zn atoms, during the recovery of vacancy-type defects an appreciable initial enhancement in the rate of clustering process is detected, depending on the thermodynamic state of the alloy. However, due to rapid elimination of the defects, after a certain aging time, the rate of the process in an irradiated alloy becomes slower than in a quenched alloy. (auth)

24207 THE SCATTERING OF LONG WAVELENGTH NEUTRONS BY DEFECTS IN NEUTRON-IRRADIATED GRAPHITE. D. G. Martin and R. W. Henson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phil. Mag. (8), 9: 659-72(Apr. 1964).

The additional elastic scattering of monochromatic neutrons, wavelength 7.5 Å, produced by irradiating a sample of AGXP graphite to a dose of 6×10^{19} fast neutrons/cm^2 at 30°C was measured as a function of the scattering angle. If it is assumed that equal concentrations of vacancies and interstitials are present and also that the vacancies scatter isotropically, an estimate of the state of agglomeration of the interstitials may be made, provided that allowance is made for the relaxation of the neighboring atoms. The result is 4 ± 2 interstitials per cluster; the values of the interstitial and vacancy concentrations are each about 2%. The radiation produced scattering disappears almost completely after an anneal at 1100°C for one hour, while at intermediate temperatures the shape of the scattering curve is identical to that obtained in the irradiated condition. Thus it is suggested that the predominant annealing mechanism in this temperature range is not the free migration of particular sizes of small interstitial clusters. (auth)

24208 REHOMOGENISATION KINETICS OF IRRADIATION-SEGREGATED Cu–Ni. A. Ascoli, M. G. Belloni, and G. T. Queirolo (Laboratori CISE, Milan). Phys. Letters, 9: 305-6(May 1, 1964).

Experimental evidence of formation of segregation zones in fast-neutron-irradiated Cu–35.7 at. % Ni alloy is presented, and the simple kinetics of redistribution of the zones are discussed. The irradiated samples were annealed at up to 700°C. (R.E.U.)

24209 STUDIES OF THE INFLUENCE OF GAMMA AND BETA IRRADIATIONS ON DISLOCATIONS IN COPPER. Livio Verdini (CNR, Rome). Ric. Sci., Rend., Sez. A, 4: 91-106(Jan. 1964). (In Italian)

By means of an ultrasonic technique the elastic energy dissipation coefficient Q^{-1} and the elastic modulus E were measured in a copper polycrystalline specimen in order to study the effects of room temperature gamma and beta irradiation on dislocation segments. A quite different behavior was found between the specimen permanently deformed and the same specimen after an annealing treatment at high temperature. In the first case the bombardment produces no appreciable changes on the two considered parameters and particularly the height of the Bordoni peak, that is the maximum of dissipation due to the relaxation motion of dislocations, is not reduced. In the second case large effects were detected either in the dissipation coefficient or in the elastic modulus: at room temperature a dose of 9×10^{16} gamma/cm^2 is able to reduce the coefficient Q^{-1} from 135×10^{-5} to 30×10^{-5} and to increase the elastic modulus E by 0.9%. The measurements carried out after a subsequent annealing treatment show an increase of dissipation and a decrease of the modulus pointing out that the point defects created by gamma irradiation are responsible for a pinning effect of dislocation lines, which are then unpinned by the thermal treatment. Some hypotheses are also proposed for the understanding of the high dissipation that is present at room temperature in copper and in some other fcc metals after a high temperature annealing treatment. (auth)

24210 THE INFLUENCE OF HEAT TREATMENT AND NEUTRON IRRADIATION OF THE ELECTRIC AND MAGNETIC PROPERTIES OF GOLD–MANGANESE ALLOYS. Werner Koester and Rolf E. Hummel (Max-Planck-Institut für Metallforschung, Stuttgart). Z. Metallk., 55: 179-85 (Apr. 1964). (In German)

Measurements of electrical resistivity, thermoelectric power, Hall constant, and magnetization in a gold alloy with 18 to 25 at.% Mn are reported as a function of mechanical and heat treatment and neutron irradiation. The ordered phase α' formed in an alloy with the stochiometric composition Au_4Mn by transition from the neighboring α^* phase, whereas the transformation from α^* into α' occurred through an intermediate stage with a superstructure similar to the periodic arrangement of antiphase domains. The transformations are explained by the high energy of nucleation of the more stable phase. The kinetics of this process were investigated by measurement of thermoelectric power. The shape of the isotherms was influenced by the favored tendency to approach equilibrium at high temperatures and a tendency to transform with increased undercooling (low temperature). The data can be interpreted by the assumption that due to the nucleation difficulties of the α' phase, the field of the α^* phase extends below 450°C metastable to the gold-rich side of the diagram. The formation of α' is hampered by cold working and especially by radiation due to the destruction of α' nuclei. This can be confirmed by magnetic measurements. (auth)

24211 WORK HARDENING OF NEUTRON-IRRADIATED COPPER SINGLE CRYSTALS. II. DEPENDENCE OF INDIVIDUAL GRAIN SIZES ON THE HARDENING CURVE ON IRRADIATION DOSE, DEFORMATION TEMPERATURE, AND STRAIN RATE. Armin Rukwied (Max-Planck-Institut für Metallforschung, Stuttgart). Z. Metallk., 55: 205-16 (Apr. 1964). (In German)

The dependence of the work hardening parameters of the individual work hardening stages in neutron-irradiated copper single crystals were analyzed as a function of neutron dose, temperature of deformation and strain rate; these dependences reflected, to some extent, pronounced differences between the different types of curves. The length of the yield point elongation zone, a_F, increased with neutron dose in type A 1, remained constant in type A 2, and increased differently in the types B and C. With increasing deformation temperature a_F decreased in type A and increased in type C. The work hardening curves of type A were rather similar to the ones of unirradiated crystals. The initial stress of stage III, τ_{III}, and the fracture shear stress, τ_E, where necking starts, were constant in type A. With increasing deformation the curves converged to the ones of unirradiated crystals. The work hardening rate of the main substages of stage II decreased with increasing neutron dose and showed, contrary to unirradiated crystals, a pronounced dependence on deformation temperature. The work hardening coefficients of stage II in surves of type C were considerably higher than those of the end of the dose range of type A 2. As in type A, there was also in type C a pronounced temperature dependence of the work hardening coefficients of stage II, the work hardening rate decreased with increasing deformation temperature. The initial shear stress of stage III, τ_{III}, increased with increasing neutron dose. There seemed to be no direct connection between τ_{III} of irradiated and unirradiated crystals. The fracture shear stress, τ_E, also increased with neutron dose, while the corresponding shear strain, a_E, decreased only slightly. In type B the substages showed more complicated dependences on neutron dose, deformation temperature, and strain rate. Thus, the curves of type B were considered to be a prestage of type C, but they also exhibited some of the characteristics of the curves of type A 2. (auth)

METEOROLOGY

24212 (HW-SA-3167) PRECIPITATION SCAVENGING EFFICIENCIES FOR ZINC SULFIDE PARTICLES. R. J. Engelmann (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 29, 1964. Contract AT (45-1)-1350. 23p. (CONF-173-5)

From the American Meteorological Society 44th Annual Meeting, Los Angeles, Jan. 1964.

Precipitation scavenging research conducted in the lower atmosphere confirms a peak collection efficiency for raindrops of about 0.4-mm diameter and suggests a minimum efficiency for drops of 0.7 to 1.0-mm diameter. The efficiency of collection of the zinc sulfide tracer was found to increase with particle size at a much greater rate than interception theory would permit. These findings represented a significant deviation from Langmuir's predictions. Based on the drop cross section, efficiencies well in excess of 1.0 were observed. Physical factors giving rise to the high efficiencies are discussed. (auth)

24213 VERTICAL DISTRIBUTION OF RADON IN THE BOUNDARY LAYER OF THE ATMOSPHERE (FROM 0 TO 300m) AS A FUNCTION OF METEOROLOGICAL CONDITIONS. T. I. Sisigina. Izv. Akad. Nauk SSSR, Ser. Geofiz., No. 3, 414-21(Mar. 1964). (In Russian)

Effects of meteorological variables upon the vertical distribution of radon in the atmosphere (from 0 to 300m) were measured. The concentration of radon in the atmosphere depends on evaporation. During dry periods radon mixing with the air is 2 to 3 times greater than during wet periods when the emanation from soil is decreased. Characteristics of turbulent vertical mixing were determined. (R.V.J.)

PHYSICS

General

24214 (AED-C-23-01) HIGH-ENERGY PHYSICS. Series C: Bibliographies. Section 23, No. 1. K. Mellentin, comp. (Deutsches Elektronen-Synchrotron, Hamburg). Mar. 1964. 38p.

References (1503) for literature on high energy physics received at DESY after 1962 are presented. Experimental and theoretical studies of interactions, strange particles, and various topics in general physics are covered, together with field theory and methods and instruments. (D.C.W.)

24215 (RM-4093-PR) NON-LINEAR INTERACTIONS OF ELECTROMAGNETIC FIELDS WITH MATTER. H. T. Yura (RAND Corp., Santa Monica, Calif.). May 1964. Contract AF49(638)-700. 51p.

Non-linear interactions of the electromagnetic field with an isotropic, homogeneous medium are considered. A quantum mechanical theory of two-phonon propagation is presented, and an integral equation for the two-photon Greens function is derived. The classical non-linear macroscopic Maxwell equations, which take into account double-photon effects, are obtained; and the phenomenological parameters that appear in these equations are related to their corresponding quantum mechanical parameters. In particular the nonlinear polarizability and conductivity of an atomic system are derived. Numerical estimates of the nonlinear terms are given, and application of this theory to the absorption of laser light in an atomic medium is discussed. Specifically, it is argued that in the case of a double resonance, the nonlinear absorption rate can be larger than the linear absorption rate. (auth)

24216 (Y-1470-B) X-RAY FLUORESCENCE TABLES: TOPAZ CRYSTAL. W. P. Amsbury, W. W. Lee, J. H. Rowan, and G. E. Walden (Union Carbide Corp. Nuclear Div. Y-12 Plant, Oak Ridge, Tenn.). Apr. 24, 1964. Contract W-7405-eng-26. 116p.

A critical compilation of standard reference tables of x-ray fluorescence lines was published in convenient form for experimental use. This section of the report contains tables calculated for a topaz crystal. Tables are arranged by element, order, and line, and also angular tabulations are given. (auth)

24217 (AEC-tr-6316(p.9-16)) GAMMA ABSORPTION ADJACENT TO SCATTERING BODIES. I. EXPERIMENTS WITH SEVERAL MODELS. Yota Nakai, Harumi Izura, Kiichi Kimura, and Koji Matsuda. (Translation)

The boundary effect in the transmission of gamma radiation through a medium with a boundary is due to the secondary electrons emitted by one of two dissimilar materials. It is assumed that the secondary electrons are produced entirely by the Compton effect and follow the angular distribution of the Klein-Nishina equation. The boundary effect was studied for polyvinyl chloride in combination with aluminum, iron, and lead scatterers, using models for forward, back, and non-directional scattering. Calculations of the electron energy are given, and the assumptions involved in the Spiers treatment are discussed. (D.L.C.)

24218 (AEC-tr-6316(p.17-23)) GAMMA ABSORPTION ADJACENT TO SCATTERING BODIES. II. APPROXIMATE CALCULATIONS. Yota Nakai. (Translation)

Spiers' theoretical treatment of the absorption of low-energy x rays near the junction of two dissimilar materials is extended to gamma rays of ~1 Mev energy. The absorption distribution of the secondary electrons is fitted to a Gaussian distribution, and the absorbed gamma dose is calculated. The wall effect is considered. (D.L.C.)

24219 (AEC-tr-6316(p.31-4)) MEAN BETA ENERGY DISTRIBUTION IN ABSORBERS. Yota Nakai. (Translation)

The average energy distribution in an absorber at a depth x when a beta flux is directed normal to a semi-infinite aluminum medium was experimentally determined. The functions N(x) and Φ(x), the number of beta particles at depth x and the energy bundle passing beyond the depth x respectively, were measured at beta energies from 0.8 to 1.8 Mev. For 1.0-Mev electrons, the extrapolated range is Re 412 mg/cm^2, the $-\Delta$Re is 20 mg/cm^2, and $-\Delta$E is 0.038 Mev. (D.L.C.)

24220 (AEC-tr-6316(p.603-8)) SATURATION FACTOR OF FREE RADICALS. Yuzuru Fujiwara, Zenichiro Kuri, and Shoji Shida. (Translation)

The great effects of microwave input on the form and degree of the ESR absorption, called saturation effects, are a problem. After a theoretical treatment of the effects, saturation factors were experimentally determined for a large number of irradiated polymers. (D.L.C.)

24221 AN AXIOMATIC APPROACH TO DIMENSIONS IN PHYSICS. Michael Parkinson (Univ. of Chicago). Am. J. Phys., 32: 200-5(Mar. 1964). (EFINS-63-14)

A set of axioms and a formalism are presented for handling units and dimensions. One form of the Π theorem is proved, and the legitimacy of transcendental functions of a dimensional quantity and the validity of expressing the laws of physics by unit-free functions are confirmed. (D.C.W.)

24222 BETA-SPECTRA OF Ce-144. Masatosi Fujishiro and Tosio Azuma. Ann. Rept. Radiation Center Osaka Prefect., 4: 86-9(1963).

The beta spectra of ^{144}Ce were studied. The results obtained were five beta groups of 320 ± 5, 260 ± 4, 240 ± 4, 185 ± 4, and 130 ± 4 kev. The experimental arrangement used is described. (P.C.H.)

24223 RADIATIONLESS RESONANCE ENERGY TRANSFER FROM UO_2^{2+} TO Nd^{3+} IN COACTIVATED BARIUM CROWN GLASS. H. W. Gandy, R. J. Ginther, and J. F. Weller (Naval Research Lab., Washington, D. C.). Appl. Phys. Letters, 4: 188-90(June 1, 1964).

The transfer of optical energy absorbed by the uranyl ion to neodymium ion that in turn emits characteristic radiation was studied for barium crown glass doubly activated with uranium and neodymium. Room temperatures were maintained. (R.E.U.)

24224 THE MONOCHROMATIZATION OF X RAYS. Jan Čermák (Inst. of Solid State Physics, Czechoslovak Academy of Sciences, Prague). Cesk. Casopis Fys., 13: 219-40(1963). (In Czech.)

A survey is given of the common methods of monochromatizing x rays; it deals with both direct methods (monochromatization by total reflection, absorption, and diffraction on single crystals) and indirect methods (particularly amplitude analysis of the pulses from proportional and scintillation counters). The main attention is devoted to diffraction methods. A description is given of the usual arrangements of crystal monochromators with one and two plane or curved crystals for different geometrical arrangements of the source and crystals. The more important properties of all the arrangements are given as well as comparisons which are important for practical application. (auth)

24225 ULTRA-HIGH-VACUUM APPARATUS FOR PREPARING AND STUDYING THE ELECTRICAL PROPERTIES OF THIN METALLIC FILMS. Jaroslav Pačes and Pavel Šuda (Inst. of Physics, Czechoslovak Academy of Sciences, Prague). Cesk. Casopis Fys., 13: 272-7 (1963). (In Czech.)

A description is given of ultra-high-vacuum apparatus with mercury diffusion pumps, in which a pressure of 3×10^{-11} torr is obtained and in which metallic films can be deposited at a pressure of 5×10^{-9} torr or more. The apparatus is equipped for measuring the electrical properties of thin ferromagnetic films without removing them from the vacuum. (auth)

24226 THE STRUCTURE OF THE SLOW SHOCK IN A TWO-FLUID SCHEME WITH DISSIPATION. Roger Peyret (Institut H. Poincaré, Paris). Compt. Rend., 258: 3178-81 (Mar. 23, 1964). (In French)

In a sequel to the article published in Compt. Rend., 258: 2973(1964), the structure of the slow shock in a two-fluid system subject to a dissipation by the Joule effect was studied. The behavior of the solution when the characteristic coefficients of the Joule effect and of the effect of the two fluids tend toward zero is considered. (tr-auth)

24227 THE INTERPRETATION OF SHOCK RELATIONS IN RELATIVISTIC MAGNETOHYDRODYNAMICS. Henri Perrin (Faculte des Sciences, Lille). Compt. Rend., 258: 3203-6(Mar. 23, 1964). (In French)

The interpretation of the shock relations in conveniently chosen references shows that the fluid velocity and the magnetic field can be made colinear if the vector $i\beta = n_\alpha \dot{H}^{\alpha\beta}$ is oriented in time; the magnetic field can be made tangential to the shock wave if $i\beta$ is oriented in space; the case where β is zero vector is irreducible to one of the preceding cases. (tr-auth)

24228 TIME MODULATION OF RECOILLESS NUCLEAR RESONANCE FLUORESCENCE. Č. Muzikář (Charles Univ., Prague). Czech. J. Phys., 14: 89-95 (1964).

The time dependence of the resonance fluorescence of nuclei excited by the spontaneous radiation of identical nuclei is studied. Particular attention is paid to the influence of the periodic overlap of the source on the form of the scattered radiation line and it is shown that the line may even split. A mechanical filter permitting measurement of pure radiation scattering is calculated. (auth)

24229 STIMULATED EMISSION PROCESSES IN SOME RARE EARTH CHELATES. Charles Brecher, Alexander Lempicki, and Harold Samelson (General Telephone and Electronics Labs., Inc., Bayside, N. Y.). Nature, 202: 580-1(May 9, 1964).

It is proposed that previously observed optical emission in terbium chelates is not stimulated emission but involves the existence of a state in which the electrons can accumulate and which has a lifetime comparable with the flash lifetime. This interpretation is based on work with europium chelates of thenoyltrifluoroacetone, benzoylacetone, and dibenzoylmethane and with the terbium chelate of benzoylacetone. (C.E.S.)

24230 ENERGY AND ELASTIC MODULI OF A LATTICE OF VORTEX LINES. J. Matricon (Faculté des Sciences, Orsay, France). Phys. Letters, 9: 289-91 (May 1, 1964).

The energies and elastic moduli were calculated for two lattices of Abrikosov vortex lines in a superconductor of the second kind with $K \gg 1$ and $H \ll H_{c2}$. A triangular lattice was found to be more stable than a square. (R.E.U.)

24231 THE GENERAL THEORY OF TRANSPORT PROCESSES AND THE CORRELATION FUNCTION METHOD. [PART] II. I. Prigogine, P. Resibois, and G. Severne (Université Libre, Brussels). Phys. Letters, 9: 317-18(May 1, 1964).

Deviations from the correlation function method for strongly coupled systems are shown to be canceled in the frame of classical linear theory so that the expressions given by the correlation function method are recovered. Exact equivalence between the two formalisms to all order in the coupling constant may be shown starting from the autocorrelation expression of Part I (NSA 17: 39759); the calculation is outlined. (R.E.U.)

24232 GRAVITATIONAL FIELD: EQUIVALENCE OF FEYNMAN QUANTIZATION AND CANONICAL QUANTIZATION. H. Leutwyler (Princeton Univ., N. J.). Phys. Rev., 134: B1155-82(June 8, 1964).

The transition amplitude for the gravitational field as given by the Feynman sum-over-histories expression is analyzed in analogy to the electromagnetic transition amplitude. The analysis is based on an explicit representation of the Feynman sum by means of a lattice. The measure is found by consistency requirements and differs from those proposed by other workers. Particular attention is paid to the subsidiary conditions associated with the gauge group. It is shown, that the approach is equivalent to the quantization by means of canonical variables as proposed by Dirac. (auth)

24233 SOLUTION OF TWO MASTER EQUATIONS COUPLED BY PARTICLE EXCHANGE. D. Levine (Operations Evaluation Group, Arlington, Va.) and P. H. E. Meijer. Physica, 30: 615-24(Mar. 1964).

The steady state is calculated in approximation for two linearly coupled master equations representing Gaussian Markoff processes. The solution is used to calculate the perturbation of particle exchange on the temperature and stream velocity of two adjacent gas layers moving tangentially past each other. (auth)

24234 LONG-RANGE H^1-H^1 SPIN-SPIN COUPLING IN NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY. S. Sternhell (Commonwealth Scientific and Industrial Research Organization, Chatswood, New South Wales). Rev. Pure Appl. Chem., 14: 15-46(Jan. 1964).

A review is presented on the mechanism of spin-spin coupling, long-range coupling, and structures exhibiting long-range H^1-H^1 interactions. The present state of theoretical knowledge on the various facets of long-range coupling in NMR spectroscopy was evaluated and pertinent data are given. It was concluded that with the exception of acetylenic, allenic, allylic, and homoallylic systems, the phenomenon of long-range H^1-H^1 coupling has not been subject to much systematic study, and the data are widely scattered. Thus there is considerable scope both for a theoretical approach and for systematic empirical observation. 306 references are included. (P.C.H.)

24235 PYROMETRIC INVESTIGATION OF AIR, NITROGEN, AND ARGON BEHIND A SHOCK WAVE. F. S.

Faizullov. Tr. Fiz. Inst., Akad. Nauk SSSR, 18: 105-58 (1962). (In Russian)

A review is given of theoretical and experimental data in shock tube performance. Various methods of shock wave measurement were compared. A spectroscopic method of measuring temperatures of gases heated by shock waves is described, and the results of pyrometric studies of nitrogen, argon, and air behind a shock wave at 1500 to 3000°K are compared with theory. 111 references. (R.V.J.)

24236 PYROMETRIC INVESTIGATION OF GAS STATES BEHIND REFLECTED SHOCK WAVES. E. M. Kudryavtsev, N. N. Sobolev, L. N. Tunitskii, and F. S. Faizullov. Tr. Fiz. Inst., Akad. Nauk SSSR, 18: 159-200(1962). (In Russian)

Measured temperatures of nitrogen, air, oxygen, carbon dioxide, and argon behind reflected shock waves were correlated with one-dimensional gasodynamic theory. The correlations were carried out under the assumption that the state of a gas behind a reflected wave is determined by the velocity of the incident wave. A photoelectric variation of the usual method for spectral line conversion was used in investigations at T_2 = 2500 to 4700°K. The presence of chaotic temperature fluctuations behind the reflected wave was observed, however, how real the fluctuations were has not been determined. For Ar$-N_2$, air, oxygen$-CO_2$ (or one, two, and three atom gases) it was concluded that the bifurcation leads to a slow increase of the T_5 magnitude behind the reflected wave which poses a limitation in the investigation. Experiments with argon in a shock tube showed a considerable drop in T_5 temperature immediately (~40μsec) behind the wave front, however, the temperature returns to a temperature close to the initial. (R.V.J.)

24237 ON THE GEOMETRIC FOCUSING OF FAST PARTICLE BEAMS BY ARBITRARILY EXTENDED CATHODES. H. Klumb (Universität, Mainz). Vakuum-Tech., 13: 3-6(Feb. 1964). (In German)

A new type α beam generator tube has been developed and investigated in detail. It is shown that by means of disk-like devices of radial symmetry with slit cathodes the beams which originate from annular cathode slits of any extension can be focussed by the geometry of the tube only, whereby considerable ion densities can be obtained. By using voltages between 10^4 and 2×10^4 v and discharge currents of between 1 and 50 ma well defined disk-like beam patterns were obtained. By introducing targets nuclear and chemical reactions can be obtained under the influence of the bombardment by fast ions of high density. (auth)

24238 THEORY OF A FERROMAGNETIC FERMI FLUID. P. S. Kondratenko (Inst. of Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 46: 1438-55(Apr. 1964). (In Russian)

The low temperature properties of a ferromagnetic Fermi fluid are investigated by quantum field theory methods. (auth)

Accelerators

24239 (AFOSR-J1340) EXPERIMENTAL STUDIES IN NUCLEAR PHYSICS. Final Report, July 1, 1963–October 15, 1963. Franklin B. Shull (Washington, Univ., [St. Louis]). 4p. (AD-426572)

The rebuilding of a 54-in. cyclotron into a sector-focused cyclotron is discussed, with emphasis on the work completed on the magnetic field, the r-f system, and the vacuum system. (T.F.H.)

24240 (CERN-64-20) SYNCHRONIZATION BETWEEN A 300-Gev SYNCHROTRON AND ITS BOOSTER INJECTOR. L. Resegotti and W. Schnell (European Organization for Nuclear Research, Geneva). Apr. 23, 1964. 34p.

The transfer of a beam from the r-f system of a synchrotron injector to the r-f system of the synchrotron is discussed. The particle momentum and r-f phase are of principle concern. The booster for a 300-Bev synchrotron is a rapid cycling AG synchrotron with 20 to 30 H_2 repetition and maximum energy of 3 to 10 Bev. Beam bunching and phasing are discussed. (R.E.U.)

24241 (CERN-64-22) A THEORETICAL AND EXPERIMENTAL COMPARISON OF PROTON AND DEUTERON ACCELERATION IN THE CERN LINEAR ACCELERATOR (CLA). Th. Sluyters (European Organization for Nuclear Research, Geneva). Apr. 21, 1964. 30p.

Deuteron acceleration in the CLA is possible if an r-f cell length of 2βλ is used, instead of the βλ length used for protons. A maximum deuteron trapping of 50% was measured for emittances of the pre-injector smaller than 4.0 cm mrad. A maximum deuteron beam intensity of 7 mamp (10 μs pulse length) was obtained at 23 Mev with an emittance of <3.0 cm mrad and an energy spread of <100 kev for 65% of the beam. Higher efficiency can be expected with an increased electrical field at the input end of the accelerator and a stronger focusing system in the first cavity. The dose rate at the input end of the machine is <1 mrem/h using a deuteron source of 120 mamp.·15 μs/s, and at the output end the dose rate is <20 mrem/h. (auth)

24242 (CONF-22-33) PRECISION ACCELERATOR VOLTAGE MEASUREMENTS WITH A GENERATING VOLTMETER. C. E. Hollandsworth, S. G. Buccino, and P. R. Bevington (Duke Univ., Durham, N. C.). [1963]. Contract AT(40-1)-1067. 8p.

From American Physical Society, 1963 Annual Meeting, New York, Jan. 1963.

The feasibility of using a precision a-c digital voltmeter with a generating voltmeter for direct-reading measurements of the terminal voltage of Van de Graaff accelerators was investigated. The system was found to be linear from 0.5 to 4.0 Mev, insensitive to changes in operating conditions of the accelerator, and stable to within a few kilovolts for periods of several days. The linearity curve extrapolates to ≃16 kv (plus source extraction voltage) at zero energy, and it is therefore necessary to calibrate at two reaction energies. A number of modifications are described to increase the stability and reliability of such a system. (auth)

24243 (ISS-63/42) IMPIEGO DEL FASCIO INTERNO DEL SINCROTRONE NAZIONALE PER LO STUDIO DI REAZIONI (e,e′p). (PROPOSTA DI ESPERIENZA). (Use of the Internal Beam of the Frascati Synchrotron for the Study of the Reaction (e,e′p). (Experimental Proposal)). U. Amaldi, G. Campos Venuti, G. Cortellessa, G. Fronterotta, P. Hillman, and G. Matthiae (Italy. Istituto Superiore di Sanità, Rome). Dec. 4, 1963. 40p.

Most nuclear experiments give information primarily on the nuclear surface. The major exception has been the group of experiments of the type (p,2p) at incident proton energies above 100 Mev. These are subject to severe limitations due to the strong interaction of the protons in the nuclei. It has recently been suggested that reactions of the type (e,e′p) are much more suitable for a quantitative analysis of the binding energies and momentum distributions of nuclear protons. A study is proposed of this reaction using the internal beam of the Frascati Synchrotron, which seems eminently suitable for this purpose. The electron angle and energy will be measured using spark chambers and a magnetic field. The proton angle and energy will probably be measured using a combination of scintillators. Counting rates of several events per minute are expected. Initial studies will be made on carbon, probably followed by one medium and one heavy nucleus. (auth)

24244 (NP-13908) INZHEKTORNYI USKORITEL' ELEKTRONOV S POSTOYANNOI FAZOVOI SKOROST'YU VOLNY. (Injection Accelerator of Electrons with a Constant Phase Velocity). V. A. Vishnyakov, I. A. Grishaev, A. I. Zykov, and E. K. Ostrovskii (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut, Karkov). 1963. 12p.

Descriptions are given of the design and performance of a 6-Mev injector accelerator with a constant phase velocity. The optimum beam parameters are: 10 μa (120 μ pulse) mean current, 6.5-Mev particle energy, 8% energy straggling, 3-mm radius, 10^{-3} radian divergence, and 20 to 30° cluster phase width. Performance at optimum accelerator frequency diminishes the dependence of accelerated beam parameters on incoming parameters (initial particle energy, accelerating field intensity, and generator frequency), thus improving stability. (R.V.J.)

24245 (NP-13914) LINEINYI USKORITEL' ELEKTRONOV DO ENERGII 90 Mev. (Linear Electron Accelerator up to an Energy Level of 90 Mev). I. A. Grishaev, E. V. Eremenko, A. A. Krasnikov, G. D. Kramskoi, A. I. Martynov, V. V. Petrenko, G. L. Fursov, and A. M. Khvatkov (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut, Karkov). 1963. 21p.

Descriptions are given of the design and performance of linear electron accelerator that was used as a source of relativistic electrons. The accelerator was designed to produce 10 ma pulses of 90-Mev electrons of 2 μsec duration at 50 cps. The accelerator consists of four accelerating sections not connected by a common high-frequency source. Each section has an iris waveguide with a constant wave velocity equal to the speed of light. The operating frequency is 2798.4 ± 0.4 Mc, the accelerating field intensity is 150 kw/cm (at the waveguide), and the high-frequency field transformation efficiency is 30 to 35%. (R.V.J.)

24246 (NP-13930(p.137-8)) DAS KARLSRUHER VAN DE GRAAFF-PROJEKT FÜR FLUGZEITMESSUNGEN AN MITTELSCHNELLEN NEUTRONEN. (The Karlsruhe Van de Graaff Project for Time-of-Flight Measurements on Medium-Fast Neutrons). G. Brudermueller, R. Gauggel, D. Kompe, W. Poenitz, B. Reuter, G. Rohr, H. P. Wahl (Kernforschungszentrum, Karlsruhe, Germany); and E. Wattecamps (European Atomic Energy Community).

A 3-Mev Van de Graaff generator with a secondary compression system is being installed at Karlsruhe. A program for measurement of total reaction cross sections, (n,γ) capture cross sections, and fission cross sections with the help of the time-of-flight method in the energy region between 10 and 120 kev is being developed. (auth)

24247 (NP-13930(p.140)) EIN KOMPAKTER, LEISTUNGSSTARKER NEUTRONEN-GENERATOR MIT DUOPLASMATRON-IONENQUELLE. (A Compact, High-Power Neutron Generator with Duoplasmatron Ion Source). W. Eyrich (Kernforschungszentrum, Karlsruhe, Germany).

For measurements with pulsed neutron fields, a small compact neutron pulse generator was developed. The maximum instantaneous source strength was over 3×10^{13} neutrons/sec. A duoplasmatron ion source provides a deuteron current of up to 500 ma. (M.C.G.)

24248 (NP-13960) LINEINYI USKORITEL ELEKTRONOV NA 2 Gev KHAR'KOVSKOGO FIZIKO-TEKHNICHESKOGO INSTITUTA. (The 2-Gev Linear Electron Accelerator of the Khar'kov Physico-Technical Institute). A. K. Val'ter, I. A. Grishaev, E. V. Eremenko, et al. (Akademiia Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut, Karkov). 1963. 9p.

Descriptions and specifications are given of an accelerator with one injection section and 49 accelerating sections. The basic parameters of the accelerator are: length without exit devices, 250 m; number of sectors (without injector), 49; maximum energy, 2 Bev; energy straggling, 5%; mean acceleration current, 2 μa; beam diameter, 10 mm; pulse current duration, 1.5 μsec; and pulse frequency, 50 per sec. (R.V.J.)

24249 (UCRL-11316) FACILITIES IMPROVEMENTS AND ACTIVITY PROBLEMS ON THE 184" CYCLOTRON. Richard J. Burleigh (California. Univ., Berkeley. Lawrence Radiation Lab.). Jan. 17, 1964. Contract W-7405-eng-48. 25p. (CONF-519-1)

From Cyclotron Conference, Williamsburg, Va., Feb. 1964.

The new addition to the building, the new medical and physics caves, and improved equipment associated with the external beams are described. Some problems in working with an active machine are discussed. (auth)

24250 (AEC-tr-6316(p.413-24)) SOME CHARACTERISTICS OF THE 3-Mev VAN DE GRAAFF ACCELERATOR. Kenichi Shinohara and Tomomichi Shigematsu. (Translation)

A brief description of the accelerator is given. Measurements are reported which were made to determine the effects of the condensing coil on the beam current, to measure the beta beam energy, and to determine the beam dispersion by the scanner. (D.L.C.)

24251 (AEC-tr-6316(p.425-30)) CURRENT MEASUREMENTS ON THE VAN DE GRAAFF ACCELERATOR. Kenichi Shinohara and Tomomichi Shigematsu. (Translation)

Results are given of experimental work on measurement of the current during accelerator operation. The device for the measurement is an ionization chamber attached to the underside of the scanner. Saturation current measurements are reported. Current measurements in the case of ion recombination were studied. (D.L.C.)

24252 (JPRS-24633(p.26-42)) EFFECT OF MEDIUM ON CYCLOTRON ACCELERATION OF RELATIVISTIC PARTICLES. A. K. Gaylitis and V. N. Tsytovich. Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 6: 1103-14(Nov.-Dec. 1963).

The acceleration of relativistic electrons in a magnetic field under the influence of transverse electromagnetic waves is analyzed. The region of low frequencies for which the dielectric constant differs appreciably from unity is considered. Possible applications to the acceleration of electrons in some discrete radio emission sources are discussed. (auth)

24253 ON THE SECONDARY ELECTRON MONITOR FOR ENERGIES BELOW 20 Mev. II. EXPERIMENT WITH AN ELECTRON LINEAR ACCELERATOR. Shigeru Okabe, Tatsuo Tabata, and Rinsuke Ito. Ann. Rept. Radiation Center Osaka Prefect., 4: 44-9(1963).

The operation characteristics of the secondary electron monitor for high current pulsed electron beams were studied with a linear accelerator. Foils of various metals and those differently treated were used to investigate the efficiency drift of this monitor. In the case of rolled Al foil a drift of about 60% of the initial value was observed during the use of several tens of hours. The cause of the large drift is considered to be the high current of the electron beam used. As the foil material of the monitor for high current accelerators, Ag was found to be the best among several foils used, the drift being about one-tenth that of Al in the same bombarding time. It was observed that the monitor current is nonsaturable up to a peak beam current density of at least about 440 mamp/cm^2. The dependence of the efficiency upon the primary beam energy and the possibility of using the monitor for pulse observation were also studied. (P.C.H.)

24254 SHORT PULSING FOR LINAC. [PART] II. Shigeru Okabe, Keisuke Kawabata, Kunihiko Tsumori, and Shigeki Nakamura. Ann. Rept. Radiation Center Osaka Prefect., 4: 62-4(1963).

Descriptions are given of the method and equipment for producing short pulses on the linear accelerator. A short beam pulse having a rise-time of 20 mμ/sec and a peak current of above 100 mamp was obtained. The pulse was ascertained by deflecting the beam with an analyzer magnet. (P.C.H.)

24255 SHUT-DOWN AT THE SC. CERN Courier, 4: 44-7(Apr. 1964).

The operational principles of the synchrocyclotron are summarized; and a polarized proton source that is to be installed is discussed, together with magnetic field measurements and accelerator modifications that were made. Some experiments aimed at increasing the intensities of the secondary-particle beams without increasing the accelerated proton current are also outlined. (D.C.W.)

24256 ON THE SOLUTION OF THE STATE OF A BEAM OF ELECTRONS AT A CERTAIN PERTURBATION OF THE AXIALLY SYMMETRICAL FIELD OF AN ACCELERATOR. Ladislav Krlín (Inst. of Electronics, Czechoslovak Academy of Sciences, Prague). Cesk. Casopis Fys., 13: 449-62(1963). (In Czech.)

A solution for the state of a beam of electrons moving in a perturbed magnetic field of a circular accelerator is given. Nonlinear, time-dependent perturbation is considered in general. The problem is solved by means of transformations in the phase and by using some of the results of the theory of linear differential equations. The solution is used to determine some of the properties of the extraction of particles from circular accelerators, carried out by means of a certain inhomogeneity of the magnetic field. (For the linear time-independent case the method is known as regenerative extraction). The solution is used to determine the shape of the beam, to derive relations important for deducing the extraction and to determine the degree of defocusing of the beam caused by nonlinearities and variability of the index. It is also stated that essentially the main cause of unsuitable dispersion of the beam is the unfavorable dependence of the displacement of the optimum azimuth of the extraction on the index during the existence of nonlinearities. It is further found that for the type of betatron in question the influence of the time increase in the perturbation is not apparent during extraction. The interaction of the particles is neglected in the solution. (auth)

24257 APPROXIMATION OF EQUATIONS OF MOTION OF PARTICLE IN CIRCULAR ACCELERATOR. Z. Sedláček (Inst. of Vacuum Electronics, Czechoslovak Academy of Sciences, Prague). Czech. J. Phys., 14: 101-5(1964).

It is shown that the equations of motion of a particle in a circular accelerator with general azimuthally periodic guiding magnetic field are substantially simplified if a large number of field periods is assumed. The simplified equations permit a clear picture of the influence of the magnetic field parameters on the dynamics of the accelerated particle to be obtained easily. (auth)

24258 STABILITY OF EQUILIBRIUM ORBITS IN ISOCHRONOUS ULTRARELATIVISTIC CYCLOTRON. [PART] I. Z. Sedláček (Inst. of Vacuum Electronics, Czechoslovak Academy of Sciences, Prague). Czech. J. Phys., 14: 106-15(1964).

An investigation into the equilibrium orbits of charged particles in one variant of the isochronous ultrarelativistic cyclotron, i.e. accelerator with time independent, axially increasing magnetic field and strong focusing for accelerating charged particles at constant orbital time, is presented. Phenomena well known from the theory of oscillations of nonlinear mechanical systems (in a certain region of the parameters of a magnetic field there exist substantially two equilibrium orbits, while in another region none exist), which have no analogy in other accelerators are found. A variant of the ultrarelativistic cyclotron with axially scalloped equilibrium orbit is proposed. (auth)

24259 STABILITY OF EQUILIBRIUM ORBITS IN ISOCHRONOUS ULTRARELATIVISTIC CYCLOTRON. [PART] II. Z. Sedláček (Inst. of Vacuum Electronics, Czechoslovak Academy of Sciences, Prague). Czech. J. Phys., 14: 158-66(1964).

The stability of equilibrium orbits of charged particles in one variant of the ultrarelativistic cyclotron was studied. The Bogoljubov-Krylov method of averaging is used to show that one of the pairs of principal equilibrium orbits, which were found previously is stable while the second is unstable. The stability limit is identical with the limit of the existence of equilibrium orbits. The dependence of the frequencies of betatron oscillations on the field parameters is shown in the stability diagrams. Brief mention is made of the magnet of the variant of an ultrarelativistic cyclotron with axially scalloped equilibrium orbit. (auth)

24260 ACCELERATION OF ALPHA PARTICLES IN CYCLOTRON U-120. K. Kult, M. Karmasin, and T. Fukátko (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Czech. J. Phys., 14: 206-9(1964). (In Russian)

The modification of the U-120 cyclotron from proton and molecular hydrogen acceleration to alpha particles is discussed. The cyclotron has pole diam. of 120 cm., magnetic field intensity at center of 14.5 kOe, and D-voltage of 29 kv. (R.E.U.)

24261 APPLICATIONS OF PHOTOGRAPHIC EMULSIONS TO RESEARCH IN HIGH ENERGY NUCLEAR PHYSICS AT CERN. W. O. Lock and G. Vanderhaeghe (CERN, Geneva). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 604-10(1963).

The complexity of the experiments and of the apparatus for high-energy accelerators makes it necessary to use the best available technique for the solution of any particular problem. For certain types of experiment the emulsion technique has clear advantages over other kinds of detector. Two such types of experiment are considered. (T.F.H.)

24262 RADIALLY FOCUSING PROPERTIES OF STATIC TRANSAXIAL FIELDS. N. I. Shtepa. Radiotekhn. i Elektron., 9: 272-82(Feb. 1964). (In Russian)

An analysis was made of radial corpuscular-optical properties of axially symmetric combined electric and magnetic fields with symmetry perpendicular to the axis. It is shown that such fields are capable of forming a disc-like particle beam. Equations were obtained for the optical force of short and weak focusing systems. Data developed for nonrelativistic particles were generalized to relativistic particles. (R.V.J.)

24263 PARTICLE ACCELERATORS AT CERN. Victor K. McElheny. Science, 144: 983-6(May 22, 1964).

A review of the history and future developments on particle accelerators at CERN is presented. The future of high-energy physics in America and in Europe is also discussed. (P.C.H.)

24264 ELECTRODYNAMIC ELECTRON INTERACTIONS IN ACCELERATORS. I. E. Tamm. Tr. Fiz. Inst., Akad. Nauk SSSR, 18: 1-31(1962). (In Russian)

An approximate evaluation was made of electrodynamic interaction forces between relativistic electrons and of their effects on bremsstrahlung and bunch shape in synchrotrons. Radiation force applied to each electron cluster was determined on the basis of electrodynamic electron interactions. The three simplifications used in the analysis assume that (1) in the first approximation a single electron has harmonic oscillations near the phase point with three mutually perpendicular oscillation axis described by three different frequencies ω_1, ω_2, and ω_3. Increases in magnetic field and electron energy altering the frequency of one of the oscillations also influences the amplitudes of the other oscillations. Thus, the theory states that the effects of accelerating elements and electrodynamic forces, as a function of electron bunch configuration, are considered simultaneously and in the same approximation, (2) the electron density distribution is constant in the bunch or varies only after many resolutions of the bunch, (3) the radian length of the bunch is smaller than a unit. (R.V.J.)

24265 ON THE SYNCHROTRON THEORY. PARTICLE INTERACTIONS IN BUNCHES. S. M. Rytov. Tr. Fiz. Inst., Akad. Nauk SSSR, 18: 32-54(1962). (In Russian)

An analysis was made of particle motion in a synchrotron in the presence of Lorentz forces, the dee field, and a certain delaying force $F^T = -\mu^2 m_0 c \omega_r f(\rho, \zeta, v)v$, $v = (d\rho/d\tau, \rho(d\Theta/d\tau), (d\zeta/d\tau)$ ($\underline{m}$ is electron rest mass, c is speed of light, ω is dee frequency, ρ, Θ, and ζ are infinite cylindrical coordinates, $\tau = \omega_r t$ is infinite time, and μ is a small parameter). It was found that the effects of evenly charged elongated bunches do not influence the amplitudes of particles whose oscillations extend beyond the cluster, but in early stages of synchrotron operations inhibit the phasing of particles with amplitudes smaller than the half-length of a ϑ_m cluster. The magnitude of ϑ_m remains arbitrary and does not vary. The problem of ϑ_m variations may be resolved by considering variations in interaction forces and the respective charge motion related to the redistribution of particle oscillation amplitudes. (R.V.J.)

24266 FAST TRANSISTORIZED ELECTRONIC COMPLEX USED WITH THE SATURNE SYNCHROTRON. P. Benoit, C. Aubret, and J.-C. Dumas (College de France, Paris). p.747-53 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

A system of fast transistorized logical circuits intended for high-energy physics experiments performed around the Saturne Synchrotron is described. A shaping distributor circuit with one input channel (photomultiplier or tunnel diode) and 4 parallel output channels, a mixer circuit with shaping device, providing 10 input channels (signals from 10 photomultipliers) and one output channel, and a multiple coincidence circuit incorporating an anticoindicence channel associated with a tunnel-diode discriminator are discussed. (auth)

24267 APPARATUS FOR DIRECTING IONISING RADIATION IN THE FORM OF OR PRODUCED BY BEAMS FROM PARTICLE ACCELERATORS. (to Varian Associates). British Patent 957,342. May 6, 1964. Priority date Aug. 1, 1960, United States.

An apparatus for directing the ionizing radiation produced by particle accelerators is patented. The apparatus includes equipment for accelerating the particle beam, magnets for bending the beam, and suitable supports so that the accelerating equipment and magnets can be moved rotationally and translationally to focus the beam or to make the beam parallel regardless of the energies of its constituent particles. The accelerating equipment may be a linear accelerator, and the beam may be focused on the object to be irradiated or on a target to produce other ionizing radiation. (M.P.G.)

24268 LINEAR PARTICLE ACCELERATOR APPARATUS FOR HIGH ENERGY PARTICLE BEAMS PROVIDED WITH PULSING MEANS FOR THE CONTROL ELECTRODE. Lawrence E. Brown and Craig S. Nunan (to Varian Associates). U. S. Patent 3,133,227. May 12, 1964. Filed June 25, 1958.

A linear accelerator is designed for high efficiency, large power output, and delivery of a beam of uniform high energy. Some of the features of the accelerator are an antisag circuit for improving the low-frequency response of the pulse transformer, a control electrode for controlling the pulse width, a r-f power pickup means for properly phasing the waves in the first accelerating section, a cooling chamber, a beam scanner head designed to minimize wall damage, etc. (D.L.C.)

Astrophysics and Cosmology

24269 (NP-13801) SPECTROPHOTOMETRIC OBSERVATIONS OF SOLAR FLARES. PART I. RESULTS FROM THE VISUAL OBSERVATION OF SOLAR ACTIVITY. PART II. Final Progress Report. Mutsumi Ishitsuka (Peru. Instituto Geofísico, Lima). July 1963. Contract AF49(638)-637. 35p.

The instruments used for spectrophotometric observations of solar flares are described. A summary of the statistical studies and results derived from the flare observations is presented. (C.E.S.)

24270 (NP-13802) STATISTICS OF SOLAR FLARES. PART I. Osamu Takahashi (Peru. Instituto Geofísico, Lima). 1962. Contract AF49(638)-637. 16p.

Statistical information on the various characteristics of solar flares is presented. The solar flare's lifetime, area, H_α, width, development curve, associated filament activation, and associated sunspot group characteristics are all analyzed for each of 685 flares observed. Correlation of these parameters with one another and with flare importance and solar activity is shown, as well as the frequency distribution. (auth)

24271 (NP-13803) PRELIMINARY MEASUREMENT OF H-ALPHA FLARE SPECTROGRAMS. Mutsumi Ishitsuka, Osamu Takahashi, Francisco Dominguez Vigo, Wilma Gonzales de Dominguez, and Enrico Mattievich (Peru. Instituto Geofísco, Lima). Feb. 1963. Contract AF49(638)-637. 20p.

Twenty-two spectrograms were taken successively with the partially completed spectrograph at Huancayo, Peru, in a narrow spectral region centered on the H_α line throughout a solar flare event detected on September 7, 1962. Six of the spectrograms were traced with a microphotometer, giving the profiles shown. Three other spectrograms covering the same spectral region, but obtained from the normal region of the sun, were traced with the microphotometer. The resultant observed profile was compared with the profile mentioned in the Utrecht Atlas in order to estimate roughly the certainty of the observed profiles. The existence of considerable stray light in the spectrograph was noted. The ratio of the equivalent width of the H_α line in the normal observed profile to that of the Utrecht profile amounted to 0.80. (auth)

24272 (NP-13804) ON THE CENTER-LIMB EFFECT OF SOLAR FLARE AREA. Osamu Takahashi (Peru. Instituto Geofísico, Lima). 1962. Contract AF49(638)-637. 38p.

The visual flare area has been corrected by a factor of sec θ for real flare area. As the result of this correction, however, great discrepancy was brought into the distribution of flare area with respect to central distance on disk, and this discrepancy has been explained as due to the flare height. An actual proof of the existence of two different parts in the foreshortening effects of flare visual area and the normalized correction of flare area, from the distribution of the flare counted number with respect to the central distance on disk, is given. These two different parts are the well-known geometrical distortion and the vanishing effect near the limb. All the flares are under the influence of the limb distortion determined by a factor of 2 $(1 - \cos \theta)^2$. Besides this, due to the limb vanishing effect, a flare, which has 2.3 square degrees in area in the central region, is out of sight in the limb region. To compensate the postulate factors for the flare height effect, the correction factor sec θ is rather useful empirically within radius vector 0.00 – 0.90. Still more, the most probable flare area in the nearest region to the limb is discussed in relation to the flare lifetime-area correlation, flare composed components, and other factors. (auth)

24273 INTERSTELLAR NEUTRINO DENSITY AND COSMOGONY. L. Fodor, Zs. Koevesy, and G. Marx (Roland Eötvös Univ., Budapest). Acta Phys. Acad. Sci. Hung., 17: 171-83(1964).

The cosmic neutrino density produced by the stars is estimated. Experimental determination of this quantity would be of great importance and any discrepancy between estimated and experimental value would be of great consequence for cosmogony. A brief review of the indirect (gravitational) and direct (atomphysical) possibilities of observation is given. (auth)

24274 STUDIES OF THE PECULIAR A STARS. II. THE SILICON-ABUNDANCE ANOMALY. Leonard Searle (Carnegie Inst. of Washington, D. C. and California Inst. of Tech., Pasadena) and Wallace L. W. Sargent. Astrophys. J., 139: 793-812(Apr. 1, 1964).

Equivalent widths of the Si II lines, λ4128 and λ4130, and the Mg II line, λ4481, were measured on 10 Å/mm spectrograms of 31 Ap stars and 5 A- and B-type normal stars. Both the Si II and Mg II lines are quite insensitive to temperature and electron pressure and behave almost identically in normal A- and B-type stars. There are large variations in the relative strengths of the Si II and Mg II lines in the Ap stars which are interpreted as abundance variations, both in the Si/H ratio and the Mg/H ratio, from star to star. Balmer-line profiles were measured; those of the Ap stars do not differ systematically from those of normal stars of the same color. Published U−B and B−V colors and the Balmer-line profiles were used to deduce representative values of θ and log P_c for each star, and abundance ratios Si/H and Mg/H were derived. The Mn stars have normal abundances of both Si and Mg, while the stars in which λ4200 of Si II is strong are overabundant in Si by factors ranging from about 10 to about 60; in the λ4200-Si stars, the abundance ratio Si/Mg has an approximately constant value of about 60 times normal. All these stars have $B-V \leq 0.0$ but otherwise no dependence of Si abundance on color. The redder Ap stars, having strong lines of Eu, Cr, and Sr, are slightly overabundant in Mg and have Si abundances varying from 10 times normal to 10 times less than normal. Equivalent widths, or upper limits, were also measured for the He I line, λ4471, and for C II, λ4267, which behave in a similar manner in normal stars. In the Mn stars the lines are normal or slightly weak for the color, but in the λ4200-Si stars both C II and He I are very weak. This phenomenon was tentatively interpreted as being due to large abundance deficiencies of He and C. Finally, possible surface nuclear reactions which might produce these effects, together with the oxygen-abundance anomalies described in an earlier paper is discussed. It is pointed out that mass conservation demands that Si must have been produced from He and H in the λ4200-Si stars if, as seems likely, these stars originated with a normal composition, but no detailed nuclear mechanisms are suggested. (auth)

24275 THE FORMATION OF H_{II} REGIONS. III. A MODEL OF THE ORION NEBULA. Peter O. Vandervoort (Yerkes Observatory, Williams Bay, Wis.). Astrophys. J., 139: 869-88(Apr. 1, 1964).

A model of the Orion Nebula is described. The initial conditions governing the model are formulated on the basis of our knowledge of the present state of the nebula, and the initial value problem for the motion of the ionized gas is solved by a method similar to the method described earlier. At a certain stage of its evolution the model is in satisfactory agreement with observational results concerning the distributions of the density and the velocity of expansion. On the basis of this agreement it is estimated that the age of the nebula is about 14000–23000 years. (auth)

24276 THE FORMATION OF H_{II} REGIONS. PART IV. Peter O. Vandervoort (Yerkes Observatory, Williams Bay, Wis.). Astrophys. J., 139: 889-98(Apr. 1, 1964).

A new model for the formation of an H II region about a star of early spectral type that has formed abruptly in an infinite, homogeneous medium of atomic hydrogen is described. The present model is an improvement over an earlier model in the sense that absorption in the ionized gas of ionizing radiation by hydrogen atoms formed by the recombination of electrons and protons is now taken into account. Generally, when absorption in the ionized gas is important, the problem of the motion of the ionization front forming the boundary of the H II region and the problem of the motion of the ionized gas must be solved simultaneously. It is shown that the two problems can be solved separately in an approximation in which the departures of the density of the ionized gas from the initial density of the neutral gas are neglected in the term describing the effect of absorption in the equation governing the motion of the front. The structure of the H II region when its formation is complete is determined in this approximation for three representative cases, and it is shown that the error involved in this approximation is quite small. (auth)

24277 ON RELATIVISTIC ASTROPHYSICS. F. Hoyle (St. John's Coll., Cambridge, Eng. and California Inst. of Tech., Pasadena), William A. Fowler, G. R. Burbidge, and E. Margaret Burbidge. Astrophys. J., 139: 909-28(Apr. 1, 1964).

It is attempted to discuss the relation of massive highly condensed objects to astrophysics in general, rather than only to the radio-source problem. Because situations in which general relativistic effects play a dominant role have not received much attention in astrophysics, a brief review of the relativistic properties of collapsed objects is given in Section I of the paper. In Section II especial attention is given to two problems: (1) Galaxies may contain considerable quantities of inert or "hidden" mass, not simply in the form of white dwarfs or neutron stars. (2) Highly collapsed objects may act as energy sources, not just explosively, but over extended time intervals. The first of these problems has implications both for nucleosynthesis and for the mass-to-light properties of stellar systems. The second appears applicable to a wide range of phenomena, ranging from supernovae in our Galaxy to whole radio galaxies. A continuous source of optical synchrotron electrons appears necessary both in the Crab Nebula and in the jet of M87. It is suggested that their origin lies in processes that are physically similar and in which considerations of general relativity play a dominant role. (auth)

24278 THE EFFECT OF A CORONAL EXPANSION ON THE COMPUTATION OF AN ELECTRON TEMPERATURE FROM EMISSION-LINE INTENSITIES. Werner M. Neupert (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. J., 139: 935-40(Apr. 1, 1964).

Certain assumptions made in the calculation of a coronal electron temperature from the relative populations in two stages of ionization of an element are examined, with the conclusion that this calculation may not be valid for the particular case of the solar corona, yielding a fictitiously low value if there is an outward expansion of ions from the base of the corona into a region of higher electron temperature. A non-equilibrium formulation for the distribution of ions is presented that may better describe the actual ion distribution in the corona. An approximate calculation shows that an outward radial velocity which is small compared with the average thermal velocity of the ions is sufficient to explain the apparent observed increase in height of the maxima of emission of the Fe ion sequence with increasing stage of ionization. (auth)

24279 THE PERTURBATION OF INTERPLANETARY DUST GRAINS BY THE SOLAR WIND. E. N. Parker (Univ. of Chicago). Astrophys. J., 139: 951-8(Apr. 1, 1964).

It is expected that photoelectric emission from the interplanetary dust grains leads to a positive charge of the order of 10 volts on each grain. The Lorentz forces exerted on this charge by the magnetic fields carried in the solar wind produce large perturbations in the Kepler orbits of the grains. On the assumption that the sign of the interplanetary magnetic field reverses every few days, it is shown that the orbital inclination of particles with radii equal to or smaller than about 1×10^{-4} cm at the orbit of Earth is greatly increased by the Lorentz forces. The importance of the Lorentz perturbation increases with the distance from the Sun. (auth)

24280 THE ABSORPTION COEFFICIENT OF QUASI-MOLECULAR HYDROGEN. Philip M. Soloman (Univ. of Wisconsin, Madison). Astrophys. J., 139: 999-1003(Apr. 1, 1964).

The free-bound absorption coefficient of H + H is calculated under conditions of thermodynamic equilibrium by a detailed balancing of the emission from and absorption into the stable upper state. The results are more than two orders of magnitude smaller than those of previous calculations. A comparison with H^- and H shows that quasi-molecular hydrogen is an extremely small contributor to the total opacity of stellar atmospheres. (auth)

24281 THE TEMPERATURE OF THE SOLAR CORONA. G. M. Nikol'skii (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 345-55(1963).

The different methods for determining the electron temperature in the solar corona are discussed. 41 references. (auth)

24282 THE INTERACTION OF SOLAR CORPUSCULAR STREAMS WITH THE ATMOSPHERES OF COMETS. L. Marochnik (Inst. of Astrophysics, Tadzhik SSR). Geomagnetism Aeronomy, 3: 492-7(1963).

On the basis of the magnetohydrodynamic theory of the interaction of corpuscular streams with the atmospheres of comets, the interaction of a shock wave (arising at the time of the collision of a stream with a comet heat) and the solid comet nucleus is discussed. It is shown that, in the case of energy accumulation on the front of a wave converging on the nucleus and appreciable focusing of the wave the ejection of halos can occur. Accelerations in type-I tails are also discussed. It is shown that the observed high accelerations ($\approx 10^2 - 10^3$ cm/sec^2) arise at the time of the entry of the shock wave into a layer of gas of decreasing density (passage of a wave from the head into the tail). At this time there is a gradual dropoff of acceleration with increasing distance from the nucleus. The dependence of acceleration on distance to the nucleus a(z), derived from observational data for the Morehouse comet 1908III, leads to a distribution of density of the ionized molecules in the tail of this comet in conformity to a law close to $n \approx n_0(z_0/z)^{1.7}$, where z_0 is the radius of the nucleus, n_0 density in the nucleus, and z a coordinate read from the nucleus along the axis of the tail. The development of clouds is also considered. Cloud formations probably can arise as a result of instability of the Rayleigh-Taylor type on the shock wave front; the magnetic field localized in the clouds accounts for the observed linear dimensions ($\sim 10^9$ cm) of the latter. (auth)

24283 EFFECTS OF SOLAR FLARES IN THE E AND D LAYERS OF THE IONOSPHERE. I. N. Odintsova (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 557-62(1963).

The ionospheric effects in the E and D layers at the time of chromospheric flares of importance 2 and 3 during the IGY period are considered on the basis of data from the world network of vertical sounding ionospheric stations. A study was made of the dependence of geoactive flares, which produced effects in the E and D layers, on their position on the solar disk and on time of day. It was found that flares are the most effective in the afternoon hours (13–15 hours LT). No dependence of the effectiveness of flares on their position on the solar disk was discovered. A study was made of the time dependence between the onset of the effect in the E and D layers and luminescence of the flare in H_α; the effect in the E region is observed simultaneously with the optical flare, whereas the effect in the D region begins somewhat later. However, in a number of cases the effect in the E region begins earlier than luminescence of the flare in H_α. (auth)

24284 A RADIO METHOD OF DETECTING SOLAR FLARES. S. N. Mitra (All India Radio, New Delhi, India). J. Atmospheric Terrest. Phys., 26: 375-98(Mar. 1964).

A radio method for detecting all solar flares occurring during the daytime is described. The skywave signal strength of a distant longwave transmitter is recorded automatically and continuously. Solar flares produce an increase in the amplitude of the signal received. Comparisons with observatory data and other radio methods of detection have established the effectiveness of this method. (D.C.W.)

24285 URANIUM AND THORIUM ABUNDANCES IN STONY METEORITES. I. THE CHONDRITIC METEORITES. J. F. Lovering and J. W. Morgan (Australian National Univ., Canberra). J. Geophys. Res., 69: 1979-88(May 15, 1964).

Simultaneous determinations of U and Th in the Orgueil (type I) carbonaceous chondrite, the Mokoia and Karoonda olivine-pigeonite chondrites, and the Hvittis enstatite chondrite were made by neutron activation methods. The olivine-pigeonite chondrite abundances are similar to ordinary (i.e. hypersthene and bronzite) chondrite values reported elsewhere, but the Hvittis enstatite chondrite is depleted in both U and Th. The Orgueil carbonaceous chondrite is enriched in U relative to the ordinary chondrites, but agrees with new calculations by Hoyle of U abundances in primitive solar material. The Th abundance in Orgueil is also enriched, but is not as high as the calculated values. Th/U ratios increase and U abundances decrease from type I carbonaceous chondrites through olivine-pigeonite and ordinary chondrites to the Hvittis enstatite chondrite. If the chondrites are related in a similar sequence by way of increasing temperatures and states of reduction, U is apparently lost more readily than Th as a result of these processes. The bearing of these new data on the radioactive heat production in earth models based on the various chondrite types is also discussed. (auth)

24286 URANIUM AND THORIUM ABUNDANCES IN STONY METEORITES. 2. THE ACHONDRITIC METEORITES. J. W. Morgan and J. F. Lovering (Australian National Univ., Canberra). J. Geophys. Res., 69: 1989-94 (May 15, 1964).

Neutron activation determinations of U and Th in two diogenites (Ellemeet, Johnstown), a howardite (Binda), a eucrite (Moore County), a nakhlite (Nakhla), and an angrite (Angra dos Reis) are in agreement with the hypothesis that these achondrites were formed as a result of differentiation of an ordinary chondrite magma. The Bishopville enstatite achondrite (aubrite) has U and Th abundances consistent with an origin directly from an enstatite chondrite of the Hvittis type by simple melting and gravity separation of metal and sulfide phases. (auth)

24287 THE SUN'S ROTATION AND RELATIVITY. R. H. Dicke (Princeton Univ., N. J.). Nature, 202: 432-5 (May 2, 1964).

It is shown that the relativistic contribution to the perihelion rotation of Mercury is not so firmly established as is usually supposed and that there could easily be a discrepancy in this important observation in excess of 10 per cent. The effect of a very small solar oblateness on this perihelion rotation is considered. This small oblateness is considered as resulting from a rather rapidly rotating solar interior. Equations are also developed to determine the solar torque. (C.E.S.)

24288 WHY ARE ALL ELECTRONS ALIKE? W. H. McCrea (Univ. of London, Englefield, Surrey, Eng.). Nature, 202: 537-8(May 9, 1964).

The indistinguishability of elementary particles in the universe is considered. The questions of why the universe is a system made of sets of indistinguishable particles and why one is justified in believing that the remotest galaxies are made of the same particles are considered. (C.E.S.)

24289 PHOTONS IN MAGNETIC FIELDS. G. K. Oertel (Langley Research Center, Hampton, Va.). Nature, 202: 684-5(May 16, 1964).

The behavior of photons in a magnetic field is discussed, and it is proposed that the existence of a transverse magnetic field of several gammas in interstellar space could be responsible for the observed red shift of spectral lines emitted by distant stars and galaxies. (C.E.S.)

24290 OUTLINE OF A THEORY OF THE UNIVERSE. T. Y. Thomas. Proc. Natl. Acad. Sci. U. S., 51: 718-23 (May 1964).

An outline of a theory of epochal cosmology is given to provide the theoretical background for the discretized galactic structure. It is assumed that the universe has existed throughout the infinite past in a state devoid of ponderable matter and that it would have continued to exist in such a state except for the accidental creation of material particles. The initial stage of the universe is discussed. The termination of the initial stage with the creation of material particles is considered and is based on the possibility of such creation within the framework of the Einstein field equations. (C.E.S.)

24291 AN ENERGY-MOMENTUM TENSOR FOR COLLAPSING STARS. R. d'E. Atkinson (California Inst. of Tech., Pasadena). Proc. Natl. Acad. Sci. U. S., 51: 723-30(May 1964).

The relativistic energy-momentum tensor for a perfect fluid is modified by the inclusion of a term representing a radiation flux so as to make it applicable to a rapidly collapsing massive star. Provision is also made for a nonisotropic pressure. The components of the new tensor are obtained explicitly for the case of spherical symmetry. The determinant of the mixed tensor is invariant for transformations that preserve spherical symmetry. (C.E.S.)

24292 RHENIUM AND OSMIUM ABUNDANCES IN STONY METEORITES. J. W. Morgan and J. F. Lovering (Australian National Univ., Canberra). Science, 144: 835-6(May 15, 1964).

Neutron activation measurements of Re and Os abundances in the Orgueil, Mokoia, Karoonda, Mocs, and Hvittis chondrites indicate no fractionation of these elements between the various chondrite types. The average abundances in chondritic material are RE = 60.3×10^{-9} g/g and Os = 710×10^{-9} g/g (Os/Re = 11.5). The Re abundance in the Bishopville enstatite achondrite is about $^1/_{300}$ as much, and the Os abundances about $^1/_{100}$ as much, as the abundances in parental enstatite chondrites, indicating that most of the Re and Os in the enstatite chondrites is in the metallic phase. (auth)

24293 SOME DATA ON RADIOASTRONOMY. V. L. Ginzburg. Vestn. Akad. Nauk SSSR, 34: No. 2, 17-21(Feb. 1964). (In Russian)

The origin of galactic radiation and the nature of electrons responsible for the galactic emissions are reviewed. Galactic nuclear explosions, spectra of cosmic radiation, polarization of cosmic radiation, and the relation between radio and γ astronomy are discussed. (R.V.J.)

24294 NEW DATA AND RADIOGALACTICS. I. S. Shklovskii. Vestn. Akad. Nauk SSSR, 34: No. 2, 22-8(Feb. 1964). (In Russian)

The origin of radiogalactics is discussed, and the distribution of optical and radio intensities according to source models 3C-270 and 3C-273 was analyzed. (R.V.J.`

24295 SOME PROBLEMS IN NEUTRINO PHYSICS. G. T. Zatsepin and V. A. Kuzmin. Vestn. Akad. Nauk SSSR, 34: No. 2, 50-62(Feb. 1964). (In Russian)

A review is given of problems related to the detection of solar neutrinos and the reactions of cosmic neutrinos with matter. (R.V.J.)

Atomic Physics

24296 (AD-417517) THEORETICAL INVESTIGATIONS OF THE ELECTRONIC STRUCTURES AND STATES OF MOLECULES AND CRYSTALS. Final Technical Report, March 1, 1962–February 28, 1963. Inga Fischer-Hjalmars and Stig Flodmark (Stockholm. Univ. Inst. of Theoretical Physics). Contract DA-91-591-EUC-2270. 161p.

Theoretical studies of the ZrO_x crystal by ligand-field and energy-band methods are described. The symmetry-projection computer program (in FORTRAN) is described, for calculation of symmetry matrices for all symmetry types of any symmetry group, using either the tight-binding, ligand-field, or MO–LCAO approximations. Calculations are made of the wave functions of the OH^-, H_2O, H_3O^+, and H_4O^{2+} isoelectronic sequence, using the Mo approximation, the one-center model, and the valence-bond method. Computer methods are used extensively in the calculations required for all these studies. (T.F.H.)

24297 (AFCRL-63-558) ENERGY STRAGGLING IN A SERIES OF ABSORBING LAYERS. Scientific Report No. 1. Nathan Grier Parke, III, Wentworth Williams, Jr., and Charles H. Sherman (Parke Mathematical Labs., Inc., Carlisle, Mass.). Nov. 1963. Contract AF19(628)-2419. 17p. (AD-426775)

The Landau theory of energy straggling was extended to provide a method of calculating straggling distributions for a beam of charged particles which has penetrated more than one layer. With this method the common experimental situation in which a beam penetrates several absorbing layers before entering the material under study can be handled almost as easily as the case of one layer. The approximations involved are consistent with the Landau theory, and the results are valid for thin layers. (auth)

24298 (N64-13373) ELASTIC SCATTERING OF SLOW ELECTRONS FROM ALKALI ATOMS. W. R. Garrett and R. A. Mann (Alabama. Univ., Huntsville. Research Inst.). [1963]. 34p. (NASA-CR-55166)

The elastic scattering cross sections for slow electrons incident on sodium and potassium are calculated using a model for the polarization potential that was earlier used for cesium. In all the alkalies studied, the low energy scattering cross sections show an extreme sensitivity to the exact shape of the polarization potential in the region where r is comparable to the atomic radius, indicating the necessity of having an accurate description of the polarization term in the total scattering interaction potential. An attempt is made to derive the polarization potential applicable to the low energy collision problem, and calculations are made for electron–cesium atom collisions. It is found that the derived polarization potential has general features similar to those of the model. The results are compared with available experimental data. (auth)

24299 (NP-13930(p.56-7)) ZUR STREUUNG LANGSAMER NEUTRONEN AN ROTIERENDEN MOLEKÜLEN. (On the Scattering of Slow Neutrons on Rotating Molecules). H. Stiller (Kernforschungsanlage, Jülich, Germany).

Investigations of molecular rotating states by scattering of slow neutrons are discussed. Experimental results for methane are described. (M.C.G.)

24300 (NP-13953) AN EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF RADIATION ON THE PROPAGATION OF ELECTROMAGNETIC SIGNALS IN AIR. Second Quarterly Progress Report. M. N. Hirsch and P. N. Eisner (Dewey (G.C.) and Co., Inc., New York). Dec. 31, 1963. Contract DA-36-039-AMC-03278(E). 37p. (R-173-2)

Operating tests of mass and optical spectrometers are described. The mass spectrometer is tested using an electric discharge in an air–Ar mixture. Results of measurements on N_2-O_2 mixtures using the optical spectrometer are reported. The N_2-O_2 spectra are excited by electron bombardment. The electron loss frequency at low electron densities in air is calculated. (T.F.H.)

24301 (FTD-TT-64-176) NEUTRALIZATION OF AN ION BEAM WITH ELECTRONS IN A MAGNETIC FIELD. V. N. Danilov. Translated from Tr. Fiz. Inst., Akad. Nauk SSSR, No. 10, 80-6(1962). 12p.

The neutralization of a one-dimensional ion current flowing to infinity, with electrons in the presence of a weak magnetic field is examined. (auth)

24302 THE SCATTERING CROSS-SECTION OF LOW ENERGY ELECTRONS IN THE THOMAS-FERMI THEORY. C. Malinowska (Technical Univ., Lodz, Poland). Acta Phys. Polon., 25: 149-54(Feb. 1964).

An analytical expression for the total cross section σ_0 for low energy electrons scattered by the Thomas-Fermi atom is derived. Numerical results σ_0 for several atomic numbers Z are given. (auth)

24303 CALCULATIONS ON THE MAGNITUDE OF STATE OF A SHOCK WAVE WITH REGARD TO THE TEMPERATURE DEPENDENCE OF THE SPECIFIC HEAT. R. Kuthe (Technische Hochschule, Brunswick). Ber. Bunsenges. Physik. Chem., 68: 42-6(1964). (In German)

A third-order equation for the calculation of the temperature immediately behind a shock front spreading in a given gas is stated. The pressure behind the shock wave and the parameters describing the state of the gas in front of the wave are assumed to be known. The treatment is based on the Rankine-Hugoniot equation for stationary shock waves and the ideal gas law. A three-term power series is used to allow for the temperature-variation of the heat capacity c_v. In addition, equations are given for the calculation of the other shock wave parameters, viz. density, spreading velocity, and dynamic pressure, from the pressure and temperature. The equations are applied to the calculation of the parameters for a shock wave in air. (auth)

24304 BACKSCATTERING OF KILOVOLT ELECTRONS FROM THIN FILMS. H. Kanter (Westinghouse Electric Corp., Pittsburgh). Brit. J. Appl. Phys., 15: 555-9(May 1964).

The angular distributions of electrons backscattered from thin films of Al and Au were measured in order to illustrate the relative importance of single and multiple scattering and diffusion in the backscattering process. The data obtained tend to support the assumption that the diffusion process is important for backscattering in material with small as well as large Z. Single elastic scattering acts can have little influence at small Z and appear to contribute noticeably only at large Z, contrary to the predictions of a recent simple theoretical model employed by Everhart and Archard. (auth)

24305 ELECTRON THEORY OF TRANSISTION METALS. S. V. Vonsovskij and Ju. A. Izjumov. Fortschr. Physik, 12: 1-137(1964). (In German)

The electron structure of atoms of transition elements and the electronic properties of transition metals are described. The zone model for transition-d-metals and a model for the interaction of outer valence electrons and electrons of incomplete inner shells are discussed. The properties of the spin system of a transition metal, including the Hamilton operator, spin polarization of conduction electrons, indirect exchange interactions of electrons of unfilled shells with conduction electrons, spin wave theory of ferromagnetic and antiferromagnetic materials, magnetic relaxation and resonance in ferromagnetic and antiferromagnetic materials, and the magnetic scattering of slow neutrons in ferromagnetic metal, are outlined. The energies and interactions of conduction electrons in transition metals are discussed. Conditions for the existence of superconducting states in ferromagnetic metals are considered. (276 references). (M.C.G.)

24306 REPULSIVE ENERGY BETWEEN HYDROGEN AND HELIUM ATOMS. A. K. Barua and S. Chatterjee (Indian Assn. for the Cultivation of Science, Calcutta). Mol. Phys., 7: 443-8(1963-64).

The energy of repulsion between hydrogen and helium atoms was calculated by using Inui–Nordsieck-type orbitals. The results show a significant improvement in the agreement with the experimental values over that obtained in earlier calculations. (auth)

24307 THE INELASTIC SCATTERING FACTOR FOR TRANSITIONS IN ATOMS. T. Tietz and W. Nowak (Univ. of Łodź, Poland). Nuovo Cimento (10), 32: 224-6(Apr. 1, 1964).

It is shown that the scattering amplitude for electron-electron inelastic scattering can be calculated analytically for any p-th state if the one-electron eigenfunctions are known. (L.B.S.)

24308 COLLISION THEORY OF IONIZATION OF ATOMS BY ELECTRONS. L. Vriens (Universiteit, Utrecht). Phys. Letters, 9: 295-6(May 1, 1964).

The Gryzinski theory of atomic ionization by a two-particle collision is reviewed and cross section formulas are derived classically and quantum mechanically. (R.E.U.)

24309 DYNAMICS OF A SYSTEM OF N ATOMS INTERACTING WITH A RADIATION FIELD. E. R. Buley and F. W. Cummings (Philco Corp., Newport Beach, Calif.). Phys. Rev., 134: A1454-60(June 15, 1964).

The time-dependent behavior of an idealized laser is analyzed. The analysis avoids the use of the rate equations and includes N-particle superradiant effects. Perturbation theory is not used; the dynamics of N two-level atoms interacting strongly with a single-radiation field mode yields four coupled nonlinear equations that are integrated numerically for some special cases appropriate to lasers operating under ordinary power output as well as Q-spoiling conditions. Loss effects are grafted onto the dynamical equations phenomenologically. It is seen that under appropriate conditions, the laser is expected to emit one or more appreciable subsequent output bursts following an initial giant pulse, and that the subsequent emissions may be emitted by a population that is below inversion. (auth)

24310 COLLISIONAL ELECTRON DETACHMENT FROM 20-Mev D^0 AND D^- IONS. Klaus H. Berkner, Selig N. Kaplan, and Robert V. Pyle (Univ. of California, Berkeley). Phys. Rev., 134: A1461-4(June 15, 1964). (UCRL-10892)

Cross sections for collisional electron detachment from 20-Mev deuterium atoms and negative ions were measured in H_2, He, N_2, and Ar. The cross section σ_{01} per target molecule for the ionization of neutral atoms are 2.2, 1.6, 20, and 36, respectively, in units of 10^{-18} cm^2. Results for single-electron detachment from D^- ions, σ_{-10}, are 7.5, 4.7, 58, and 75, respectively. All values have an uncertainty of ±10%, chiefly from absolute-pressure calibration uncertainties. The experimental values for atoms in H_2 and He are in agreement with calculations that use the Born and free-collision approximations. The measured cross sections for single-electron detachment from negative ions in H_2 and He are about one-half of the calculated values. The two-electron detachment cross sections, σ_{-11}, are approximately 4% of the single-detachment cross sections, σ_{-10}, in all gases. (auth)

24311 TRIPLET CORRELATIONS IN LIQUIDS. A. Rahman (Argonne National Lab., Ill.). Phys. Rev. Letters, 12: 575-7(May 25, 1964).

The results of an investigation of the superposition approximation (SA) for $g^{(3)}$ (r,r,s), the distribution of asymmetric triplets, for a system of particles at 94.4°K and with a density of 1.374 g cm^{-3}, are reported. The motion of atoms in a liquid is simulated on a computer using classical dynamics on a system of 864 particles interacting through a Lennard-Jones potential. For $s < \underline{a}$, the SA exaggerates the probability of occurrence of triplet distributions (r,r,s), and this exaggeration is greater for $r < \underline{a}$. The ratio $R_r(s) = g^{(3)}(r,r,s)/[g^{(2)}(r)]^2$ shows a secondary maximum, which reflects the short-range order arising out of the sharp first maximum in $g^{(2)}$ that occurs at $\underline{a}$. (L.B.S.)

24312 CROSS SECTIONS FOR THE ION-MOLECULE REACTION $H_2^{+*} + H_2 \rightarrow H_3^+ + H$ AS A FUNCTION OF THE VIBRATION STATE OF THE H_2^+ ION. A. Weingartshofer and E. M. Clarke (St. Francis Xavier Univ., Antigonish, Nova Scotia). Phys. Rev. Letters, 12: 591-2(May 25, 1964).

It is shown that only the first four vibrationally excited states of the H_2^+ ion contribute significantly towards the formation of H_3^+ in the ion-molecule reaction, H_2^+(vib) + $H_2 \rightarrow H_3^+ + H$. Appearance potential curves for H_2^+ and H_3^+ are presented, and the relative cross sections for the formation of H_3^+ for the various vibrational levels of H_2^+ are tabulated. (L.B.S.)

24313 VERY SHORT-RANGE INTERACTION OF A HYDROGEN ATOM AND A HELIUM ATOM. D. M. Duparc and R. A. Buckingham (Univ. of London). Proc. Phys. Soc. (London), 83: 731-8(May 1964).

The interaction energy of a hydrogen and a helium atom in the ground state was calculated for internuclear distances in the range 0 to 1 Å, using a two-configuration molecular orbital wave function. The coefficients E_2 and

E_3 in the expansion $E_0 + E_2R^2 + E_3R^3 + \ldots$, for the electronic interaction energy at small R, where R is the internuclear distance, were calculated for the ground states of H + He, He + He and H + H, using formulas given by Bingel. These formulas involve the electron charge density of the united atom, and for each system several different wave functions were used to derive E_2 and E_3, and the resulting ratios compared with another formula derived by Bingel. A recent analysis by Brown and Steiner suggests that Bingel's expression for E_3 should be doubled, and the fitting of the molecular orbital energies calculated tends to support this conclusion. For H + He and He + He a fitting of the energy was made for the range of R from 0 to the zero of the interaction energy, using calculated energies at small R, the calculated value of E_2, the experimental energy of the united atom and results derived from the scattering experiments. (auth)

24314 CROSS SECTIONS FOR n → n + 1 TRANSITIONS IN HYDROGEN PRODUCED BY ELECTRON IMPACT. H. E. Saraph (Univ. of London). Proc. Phys. Soc. (London), 83: 763-8(May 1964).

The dipole approximation given by Seaton is used to calculate cross sections for n → n + 1 transitions in hydrogen produced by electron impact. Results are tabulated for $1 \leq n \leq 40$. It is found that the results differ significantly from those obtained by Gryzinski using classical theory. It is believed that the dipole approximation gives the more reliable results. (auth)

24315 THE VIBRATIONAL DE-EXCITATION OF OXYGEN IN HETEROMOLECULAR COLLISIONS. R. Holmes, F. A. Smith, and W. Tempest (Univ. of Liverpool). Proc. Phys. Soc. (London), 83: 769-75(May 1964).

Sound absorption measurements were made in oxygen–helium, oxygen–hydrogen and oxygen–deuterium mixtures to investigate the effect of light impurities on the collisional de-excitation of vibrationally excited oxygen molecules. The results are compared with the theory of Herzfeld and Litovitz, and it is found that the calculations overestimate the efficiency of the impurity in all cases. Possible reasons for the discrepancies are discussed. (auth)

24316 GREEN BANDS OF $^{24}Mg^{16}O$ AND $^{26}Mg^{16}O$ MOLECULES. D. S. Pešić (Inst. of Nuclear Sciences "Boris Kidrich," Belgrade). Proc. Phys. Soc. (London), 83: 885-7 (May 1964).

Emission spectra in the region 5200–4800 Å were excited in a vacuum arc and a stabilized plasma jet. A vibrational analysis of the $B\ ^1\Sigma - X\ ^1\Sigma$ system was made and molecular constants for the isotopic molecules are given. The emitter is certainly MgO and the analyses of Mahanti and of Lagerqvist and Uhler are confirmed. (auth)

24317 PENETRABILITY OF ELECTRONS THROUGH ALUMINUM FOILS AT 1 TO 12 kev. A. R. Shul'man, I. R. Kanicheva, and B. F. Barzdo. Radiotekhn. i Elektron., 9: 321-32(Feb. 1964). (In Russian)

Electron penetrability and energy distribution were analyzed. The energy spectra exhibit a wide variety of energy losses. (R.V.J.)

24318 ENERGY DISTRIBUTION OF ELECTRONS EJECTED BY NEON ATOMS AND IONS. R. R. Rakhimov and Kh. Dzhurakulov. Radiotekhn. i Elektron., 9: 333-8 (Feb. 1964). (In Russian)

Energy distributions of electrons ejected by neon ions and atoms (at E_0 = 0.4 to 0.5 kev) from carefully degassed molybdenum were investigated using condenser retardation. Ion velocities exerted no influence on ejected electron energy spectra. For equal energies, the energy distribution of electrons ejected at the expense of ion kinetic energy is equal to the energy distribution ejected by atoms. At higher energies the maximum in the energy curve of ejected electrons shifts toward the higher energy side, and the specific weight of fast electrons grows faster than the specific weight of slow electrons. (R.V.J.)

24319 APPLICATION OF OMEGATRON FOR INVESTIGATING STRUCTURE OF GASES EDUCED FROM SOME VACUUM COATINGS UNDER THE INFLUENCE OF ELECTRON BOMBARDMENT. Yu. V. Zebenko, S. A. Shakirova, I. L. Sokolskaya, and Yu. I. Belyakov. Radiotekhn. i Elektron., 9: 357-9(Feb. 1964). (In Russian)

Films of platinum, tin oxide, aquadag, and silver paste deposited on glass were bombarded with electrons, and the emitted products were analyzed using an omegatron. (R.V.J.)

24320 VIBRATIONAL TRANSITION IN MOLECULAR COLLISION. V. ANOTHER SHORT TABLE OF FUNCTIONS USEFUL FOR CALCULATING THE VIBRATIONAL TRANSITION PROBABILITY. PART 2. Kazuo Takayanagi (Saitama Univ., Urawa, Japan and Tokyo Univ.) and Shobu Kaneko. Sci. Rept. Saitama Univ., Ser. A., 4: 15-21(1961).

The temperature dependent factor of the vibrational transition probability has been calculated numerically in a previous paper (Sci. Rep. Saitama Univ. A III, No. 3(1960) 167) for the intermolecular potential of the Morse type. Similar calculations are made for larger values of the energy transfer between the translational and the vibrational degrees of freedom. (auth)

24321 BEHAVIOR OF THE CHARGE TRANSFER CROSS SECTION IN THE LOW ENERGY ATOMIC COLLISIONS. Kazuo Takayanagi (Saitama Univ., Urawa, Japan and Tokyo Univ.). Sci. Rept. Saitama Univ., Ser. A., 4: 41-7(1962).

It is shown wave-mechanically that the cross section for exothermic charge transfer in an extremely low-energy atomic collision is inversely proportional to the relative velocity of collision, and also that this general conclusion is obtained without assuming the presence of the polarization force, in contradiction to the previous theories based on the semiclassical treatment. (auth)

24322 VIBRATIONAL TRANSITION IN MOLECULAR COLLISION. VI. DEPENDENCE OF THE EFFECTIVE CROSS SECTION ON THE INTERMOLECULAR FORCE, THE ENERGY TRANSFERRED, AND THE TEMPERATURE. Kazuo Takayanagi (Saitama Univ., Urawa, Japan and Tokyo Univ.). Sci. Rept. Saitama Univ., Ser. A., 4: 49-69(1962).

Behavior of the effective cross section for the vibrational transition as a function of the parameters specifying the intermolecular interaction, the energy transferred, and the temperature was investigated from numerical tables. Some extreme cases are studied analytically and then the other cases are investigated graphically. The intermolecular force is assumed to be of the Morse type. (auth)

24323 APPLICABILITY OF THE DISTORTED WAVE METHOD IN THE THEORY OF INELASTIC MOLECULAR COLLISIONS. Kazuo Takayanagi (Tokyo Univ.). Sci. Rept. Saitama Univ., Ser. A, 4: 87-94(1963).

It is shown that, for many simple diatomic molecules, the so-called perturbed stationary state method gives practically the same vibrational transition probabilities as the distorted wave method. Exceptional cases are those in which the vibrational force constant is extremely small or the colliding particles are chemically unsaturated. In these cases, the perturbation of the molecular vibration during the collision is so large that the ordinary distorted wave method becomes less reliable. (auth)

24324 DISSOCIATION OF H_2^+ IONS IN COLLISION WITH ATOMS AND MOLECULES. R. N. Ilin, B. I. Kikiani, V. A. Oparin, E. S. Solovev, and N. V. Fedorenko (Ioffe Inst. of Tech., Leningrad). Zh. Eksperim. i Teor. Fiz., 46: 1205-11(Apr. 1964). (In Russian)

The cross sections for production of protons from molecular H_2^+ ions with energies between 10 and 180 kev in hydrogen, nitrogen, helium, and argon are presented. A summary of published data on the cross sections over a broad energy range is given. (auth)

24325 ELASTIC SCATTERING AND REACTIONS OF LITHIUM IONS. J. R. J. Bennett and I. S. Grant (Manchester Univ., Eng.). p.50-3 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

A measurement was made of the elastic scattering of ^{7}Li ions by ^{7}Li and ^{12}C nuclei. The range of the nuclear interaction between lithium and the target nucleus is in both cases 8.0 fermis. (auth)

Cosmic Radiation

Refer also to abstract 24348.

24326 NUCLEAR COMPOSITION AND RIGIDITY SPECTRA OF SOLAR COSMIC RAYS. S. Biswas and C. E. Fichtel (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. J., 139: 941-50(Apr. 1, 1964).

Further studies on the composition of solar cosmic rays have been made particularly with regard to the nuclei of charge 10 or more. The results support the earlier conclusion that the composition of the multiply charged nuclei in solar cosmic rays seems to reflect that of the sun as determined by spectroscopic means for those nuclei where comparisons can be made. The relative abundances of helium and neon which cannot be determined well in the photosphere by spectroscopic means are found to be 107 ± 14 and 0.13 ± 0.02 relative to oxygen, respectively, for the energetic solar particles. The helium nuclei rigidity spectrum during one period in the November 12, 1960, solar cosmic ray event has been extended to lower rigidities than measured previously, thereby permitting a comparison to the proton rigidity spectrum over a wider interval. The result of this analysis together with previous work demonstrates that it is unlikely that any of the simple spectral forms proposed in the literature yield a consistent answer for both protons and helium nuclei for all events. (auth)

24327 SOME CHARACTERISTICS OF GEOACTIVE PARTICLES. V. I. Krasovskii, Yu. I. Gal'perin, V. V. Temnyi (Temnyy), T. M. Mulyarchik, N. V. Dzhordzhio, M. Ya. Marov, A. D. Bolyunova, O. L. Vaysberg, B. P. Potapov, and M. L. Bragin (Inst. of Atmospheric Physics, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 333-7(1963).

The equipment of the "Cosmos 3" (1962 ν) and "Cosmos 5" (1962 υ) satellites is described briefly and some results of scientific investigations conducted by means of these satellites are reported. (auth)

24328 SOME NEW RESULTS OF GEOPHYSICAL INVESTIGATIONS BY MEANS OF THE "COSMOS 3" AND "COSMOS 5" SATELLITES. V. I. Krasovskii, Yu. I. Gal'perin, V. V. Temnyi (Temnyy), T. M. Mulyarchik, N. N. Dzhorzhio, M. Ya. Marov, and A. D. Bolyunova (Inst. of Atmospheric Physics, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 338-44(1963).

The results of measurements of corpuscular radiation in the upper atmosphere by means of the "Cosmos 3" (1962 ν) and "Cosmos 5" (1962 υ) satellites are described. The recorded particles belonged to the following different energy groups: protons with an energy in excess of 50 Mev or electrons with an energy exceeding 0.4 Mev; electrons with an energy of ~ 100 kev; and electrons with an energy of the order of 10 kev. Lines of equal intensity at a height of about 650 km. above the South Atlantic magnetic anomaly are presented for the first and second groups. The rapid deceleration of "Cosmos 3" was noted. (auth)

24329 DETERMINATION OF THE COSMIC-RAY EQUATOR AT 14° WEST LONGITUDE. Yu. Dubinski, P. Khaloupka, V. Gadek, and A. Mrkos (Advanced Technical School, Kosice, Czechoslovakia). Geomagnetism Aeronomy, 3: 372-3(1963).

Results of measurement of the latitude effect of the total cosmic-ray component are given. The position of the cosmic-ray equator at 14° West was determined. (auth)

24330 THE INFLUENCE OF A RADIAL MAGNETIC FIELD ON THE DIFFUSION OF COSMIC RAYS. V. I. Shishov (Lebedev Inst. of Physics, Moscow). Geomagnetism Aeronomy, 3: 484-8(1963).

The influence of a radial magnetic field on the diffusion of cosmic rays generated during solar flares is considered. Corrections are introduced that take into account curvature of the field. A dependence on the heliocentric longitude of the flare of change of density of cosmic particles with time is derived. By a comparison with observations it was possible to determine the strength of the radial component of the interplanetary magnetic field; this is equal to 5×10^{-6} gauss near the earth's orbit and 0.1 gauss near the sun. (auth)

24331 THE SECULAR VARIATION OF COSMIC-RAY INTENSITY IN THE STRATOSPHERE (1957-1962). A. N. Charakhch'yan and T. N. Charakhch'yan (Lebedev Inst. of Physics, Moscow and Moscow State Univ.). Geomagnetism Aeronomy, 3: 489-91(1963).

More than 4000 measurements of the intensity of the charged component of cosmic rays in the stratosphere were made during the period from July 1957 through July 1962. The derived data on secular variations of cosmic-ray intensity in the stratosphere at geomagnetic latitudes 41, 51, and 64°N are discussed. It was found that the secular variation of cosmic-ray intensity in the period between the solar activity maximum and minimum is of a jump-like character. Sharp changes of intensity were observed in January-February and October-December 1961. The general variation of cosmic-ray intensity correlates with solar activity, characterized by the relative sunspot number R. A change of R is reflected more strongly in the change of cosmic-ray intensity the smaller the value of R. An increase in cosmic-ray intensity in the stratosphere during the period of declining solar activity occurs for the most part because of radiation with energies less than 4 Bev (for protons). The intensity of primary cosmic rays with energies less than 4 Bev increased late in 1961 by a factor greater than 2 in comparison with 1958. (auth)

24332 ELECTRON ACCELERATION IN THE EARTH'S RADIATION BELTS. V. N. Tsytovich (Lebedev Inst. of

Physics, Moscow). Geomagnetism Aeronomy, 3: 498-504 (1963).

It is demonstrated that radiation can lead to an appreciable acceleration of the electrons of the earth's radiation belts. The basic experimental data on the outer belt are explained qualitatively. (auth)

24333 THE DIFFUSION OF A GAS BEING ABSORBED IN A MEDIUM OF VARIABLE INTENSITY. N. P. Mar'in. Geomagnetism Aeronomy, 3: 521-8(1963).

The propagation of a gas being absorbed in the earth's atmosphere is described. It is shown that the height of the layer with the maximum concentration of absorbed particles decreases with time. (auth)

24334 THE NATURE OF THE EFFECT OF SMALL BURSTS IN THE COSMIC-RAY HARD COMPONENT. L. I. Dorman, V. I. Ivanov, E. V. Kolomeets, and I. E. Kashkarov (Kazakh State Univ., Alma-ata, SSR). Geomagnetism Aeronomy, 3: 606-7(1963).

The results of an analysis of the small-burst effect in the cosmic ray hard component are presented. The analysis was made by the superposed-epoch method for 162 flares of class 2 or greater, observed on magnetically quiet days. No increase in intensity was observed in the limits of experimental error (± 0.1%) at energies of ~15 Bev, thus, no support was given to the hypothesis of the meteorological origin of the cosmic ray small-burst effect. (L.B.S.)

24335 ANTI-MATTER IN THE COSMIC RADIATION. G. Brooks and A. W. Wolfendale (Univ. of Durham, Eng.). Nature, 202: 480-1(May 2, 1964).

It is shown that there is an upper limit of about 5 per cent to the concentration of antiprotons in the flux of cosmic particles incident at the earth with energies of the order of 1000 Bev. (C.E.S.)

24336 THE HIGH-ENERGY MUON FLUX AT SEA LEVEL OBTAINED FROM AN OBSERVATION OF THE BURST-SIZE SPECTRUM. S. Higashi (Osaka City Univ.), T. Kitamura, Y. Watase, M. Oda, and Y. Tanaka. Nuovo Cimento (10), 32: 1-13(Apr. 1, 1964).

The cosmic-ray bursts of about 11 000 events have been measured at 20 meters water equivalent underground for an observation time of 2958.7 hr by means of 8 m^2 scintillators. Following the usual Christy and Kusaka's analysis, a burst-size spectrum can give an energy spectrum of muons. From this series of experiments it is concluded that the obtained muon energy spectrum at incidences with zenith angles larger than 70 degrees is consistent with the one calculated by Allen and Apostolakis and that the energy spectrum at vertical direction is given up to 4000 Bev. The latter is compared with the energy spectrum obtained by a simple extrapolation of observed momentum spectrum by Hayman et al., using the magnetic spectrograph and with the energy spectrum calculated from the energy spectrum of γ rays in the high atmosphere. Also, the interrelation of the burst-size spectrum and the range-spectrum of muons underground is discussed. (auth)

24337 DIRECTIONAL DISTRIBUTION OF THE HARD COMPONENT OF COSMIC RAYS. P. S. Gill and M. K. Khera (Gulmarg Research Observatory, Kashmir, India). Nuovo Cimento (10), 32: 33-47(Apr. 1, 1964).

Directional measurements of the hard component of the cosmic rays, employing narrow-angle telescopes, were made at the four principal azimuths at Gulmarg (2700 m; λ = 24.7°N). The results were compared with the earlier measurements of Gill and Mitra at the same laboratory. Absolute directional intensities and flux were calculated and listed. The present vertical intensity was found to be at least 13 to 15% lower than that recorded in 1954 at the same place. The fine-structure analysis of the data indicated that the present results do not rule out the existence of anomalies in the zenithal distributions of the cosmic-ray intensity. Zenithal distributions were also compared with Quercia and Rispoli's meson differential spectra which indicated that theoretical intensities were in fair agreement with the observed intensities. The study of fractional energies, transmitted by incident protons to mesons, east-west, north-south asymmetries and south-west differences provided a possible evidence to show that geomagnetic cut-off energies as given by Lemaitre and Vallarta theory need to be revised in the N-S plane at large angles at intermediate latitudes. The data also indicated considerable variation of the east-west asymmetry with solar activity. (auth)

24338 ENERGY SPECTRUM OF DAILY VARIATION OF COSMIC-RAY INTENSITY. R. P. Kane (Physical Research Lab., Ahmedabad, India). Nuovo Cimento (10), 32: 273-92(Apr. 16, 1964).

Using neutron monitor data obtained during I.G.Y., the energy spectrum of the 18 monthly average daily variation (first harmonic r_1) is studied, using Webber and Quenby's coupling constants. No good fit is obtained for any value of the exponent m of the spectrum E^{-m}, the best fit among these being for m = 0. Rao et al.'s conclusion that m = 0 is the best answer is critically examined. Here again, the correlation coefficient between expected and observed amplitudes is only about +0.6. To check whether this could be due to mixing of different types of diurnal variations, data for days of low r_1 values ($\leq$ 0.3%) were studied separately. The study showed large scatter in amplitudes which, though partly explainable as due to larger statistical errors, perhaps indicates that there is not much of a quiet day diurnal variation of cosmic ray intensity. A similar study for days of high amplitudes ($\geq$ 0.7%) shows a correlation of about +0.6 only. A possibility of m ≠ 0 is slightly indicated. However, instrumental troubles seem to predominate. The second harmonic (r_2) shows very erratic behavior and divergent phases φ_2. (auth)

24339 THE MOMENTUM SPECTRUM OF COSMIC RAY PROTONS NEAR SEA LEVEL IN THE MOMENTUM RANGE 0.6-150 Gev/c. G. Brooke and A. V. Wolfendale (Univ. of Durham, Eng.). Proc. Phys. Soc. (London, 83: 843-51(May 1964).

A spectrograph was used to measure the momentum spectrum of cosmic protons in the vertical direction. The protons were detected by two methods: absorption in lead and neutron production in a neutron monitor. The ratio of the proton intensity to the muon intensity is found to fall with increasing momentum from 6% at 0.7 Bev/c to about 0.4% at 80 Bev/c. (auth)

24340 THE INTERRELATION OF THE PRIMARY AND SEA-LEVEL SPECTRA OF COSMIC RAYS. G. Brooke, P. J. Hayman, Y. Kamiya, and A. W. Wolfendale (Univ. of Durham, Eng.). Proc. Phys. Soc. (London), 83: 853-69 (May 1964).

Recent measurements of the sea-level spectra of cosmic protons and muons were used, together with a trial spectrum of primary nucleons, to derive values for the nucleon inelasticity K_t and the fraction of energy passed on to the pion component K_π in nucleon-air-nucleus collisions. It is shown that the values of K_t and K_π are not very sensitive to the model assumed for the collisions, and the effect of fluctuations in the values of K_t and K_π from one collision to the next is found to be small. Assuming a value for the difference $K_t - K_\pi$ based on the results of other experiments (approximately 0.12) it is possible to estimate the energy spectrum of primary nucleons in the range $10^{11} - 10^{15}$ ev/nucleon. When recent geomagnetic measurements are added, the integral spectrum is found to be represented by the expression $I(>E) = 0.87\ E^{-1.58}\ \text{cm}^{-2}\ \text{sec}^{-1}\ \text{sterad}^{-1}$ over the range $10^{10} - 3 \times 10^{13}$ ev/nucleon, where E is expressed in Bev. At higher energies the exponent increases reaching a value of about 2.1 in the region of 10^{15} ev. If $K_t - K_\pi$ is less than 0.12 the primary intensity is reduced; in the limit, with $K_t - K_\pi = 0$ the intensity is reduced by a factor of approximately 1.5. (auth)

24341 THE ENERGY SPECTRUM OF COSMIC RAY PIONS NEAR SEA LEVEL IN THE RANGE 0.7-150 Gev. G. Brooke, M. A. Meyer, and A. W. Wolfendale (Univ. of Durham, Eng.). Proc. Phys. Soc. (London), 83: 871-7 (May 1964).

The momentum spectrum of negative pions in the vertical direction was measured using a spectrograph in conjunction with a neutron monitor. Pions were detected by means of their interaction and subsequent neutron production in the monitor. The ratio of the intensity of charged pions to charged muons is found to vary slowly with energy, being in the range 0.1–0.2% in the region of energy studied. The pion spectrum was taken with the energy spectra of protons and muons to give the attenuation length for pions in the atmosphere. This quantity falls from about 160 g cm^{-2} at 1 Bev to 110 g cm^{-2} at 100 Bev; the corresponding inelasticity of pion–air–nucleus collisions increases from 50% to 100% over the same energy range. (auth)

24342 EXISTENCE OF GENERALLY EXTENSIVE SHOWERS OF PRIMARY GAMMA RADIATION. K. Suga, G. W. Clark, I. Escobar, K. Murakami, and M. La Pointe (Universidad Mayor de San Andres, La Paz, Bolivia). Publ. Lab. Fis. Cosmica, Univ. Mayor San Andres, No. 24, 7-13 (May 1963). (In Spanish)

Experimental evidence for the existence of primary cosmic gamma rays with energies near 10^{14} ev and with an intensity peaked near the galatic equator, is presented. This evidence is based on the idea that showers initiated by gamma rays should contain relatively few mesons (μ) and nuclear-active particles. The supporting data for the first results were accumulated by the Bolivian Air Showers Joint Experiment on Mt. Chacaltaya. (auth)

24343 PROPERTIES OF THE EXTENSIVE SHOWERS IN THE AIR AT 4,200 METERS ALTITUDE. I. Escobar (Universidad Mayor de San Andres, La Paz, Bolivia), I. Hersil, and G. Clark. Publ. Lab. Fis. Cosmica, Univ. Mayor San Andres, No. 24, 15-18(May 1963). (in Spanish)

Showers observed at El Alto de La Paz, Bolivia (altitude 4200 m) since 1957 to 1960 were analyzed by comparing them with the Nishimura Kamata function. It was concluded that showers with more than 10^7 particles have their maximum of development of the atmospheric depth corresponding to this station. The spectrum of shower sizes for certain values of the inclination of the shower axis is also given. (auth)

24344 VERIFICATION OF THE DIRECTION OF ARRIVAL OF EXTENSIVE SHOWERS DETERMINED IN BASJE BY DIFFERENT SYSTEMS. P. Barker, V. Domingo, and N. Martinic (Universidad Mayor De San Andres, La Paz, Bolivia). Publ. Lab. Fis. Cosmica, Univ. Mayor San Andres, No. 24, 41-3(May 1963). (In Spanish)

A comparative analysis was made of the arrival direction of showers as observed with a cloud chamber and similar observations made with the timing array for particles of a shower of BASJE experiment. Results showed a consistency between the two methods of observation. (auth)

24345 THE VARIATIONS IN THE INTENSITY OF COSMIC RADIATION AND THE ELECTROMAGNETIC STATES OF INTERPLANETARY SPACE. H. S. Ahluwalia and I. Escobar (Universidad Mayor De San Andres, La Paz, Bolivia). Publ. Lab. Fis. Cosmica, Univ. Mayor San Andres, No. 24, 57-75(May 1963). (In Spanish)

Changes in the electromagnetic states of the interplanetary space produce temporal fluctuations in cosmic ray intensity as observed on the earth. The changes in the interplanetary electromagnetic states are, on the other hand, brought about by solar wind. The study of cosmic ray intensity variations, therefore, provides a way of obtaining information regarding the parameters that characterize the solar wind at any given time. Evidence available from the study of the quite day solar diurnal variation of cosmic rays indicated that solar wind velocity is usually above 100 km/sec and that the wind velocity undergoes a 22 year cyclic change. Also it is demonstrated that the shift to earlier hours of the time of maximum of disturbed day solar diurnal variation observed during early stages of cosmic ray storms enables a choice to be made between Parker's blast wave model and the magnetic tongue model advocated by Gold and others for the configuration of interplanetary magnetic field obtainable on geomagnetically disturbed days. Observations fit the blast wave model better. A qualitative model, in which solar wind plays a major role, is presented to explain the gross features of the secular variation of isotropic intensity of cosmic rays. The model requires that the interplanetary magnetic field extend over a distance amounting to several tens of astronomic units from the sun. (auth)

24346 NUCLEAR INTERACTIONS OF COSMIC-RAY HIGH-ENERGY PARTICLES WITH LIQUID SCINTILLATOR. Hao-hwai Kuang, Shih-wei Wang, and Yu-kuei Yuan. Sci. Sinica (Peking), 13: 709-21(May 1964).

Nuclear interactions induced by high-energy cosmic particles were studied by means of a multiplate cloud chamber at 3185 m. above sea level with a liquid scintillator as the target material. From the analysis of eighteen interactions induced by charged primaries, it is found that (1), the average primary energy is E = 41 ± 8 Bev (by the Castagnoli formula), (2), the average multiplicity of charged secondaries is $n_s = 4.9 \pm 0.3$, and (3), with $x = \log \gamma_c \text{tg} \theta_1$, the differential angular distribution dN/dx indicates some possibility of existence of a double-humped shape. The angular distribution is discussed tentatively along the lines of a two-centered model. (auth)

24347 SOME RESULTS OBTAINED FROM THE STUDY OF COSMIC RAYS AND RADIATION BELTS WITH SOVIET SATELLITES AND SPACE ROCKETS. V. L. Ginzburg, L. V. Kurnosova, L. A. Razorenov, and M. I. Fradkin (Lebedev Inst. of Physics, Moscow). Space Sci. Rev., 11: 778-861(Dec. 1963).

Some experimental results obtained with Soviet space probes are presented and compared with published data. The nuclear component of cosmic radiation primarily was studied, but data on the radiation belts were also obtained. The fluxes and spectra of the nuclei were measured, and the intensity of cosmic radiation was observed. Short-period increases in the flux of the nuclear component which were associated with solar activity were observed, together with anomalies in the intensity of the radiation. 145 references. (D.C.W.)

24348 INTERACTION BETWEEN ULTRAHIGH ENERGY COSMIC RAYS AND NEUTRINOS IN THE UNIVERSE. B. P. Konstantinov and G. E. Kocharov (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksperim. i Teor. Fiz., 46: 1470-2(Apr. 1964). (In Russian)

Interaction between cosmic rays and neutrinos in the universe is considered. It is shown that for cosmic ray particles with energies exceeding 10^{20} ev per nucleon, besides interaction with hydrogen and thermal photons, nuclear reactions involving neutrinos should also be taken into account. (auth)

Criticality Studies

24349 (LAMS-3067) LOS ALAMOS CRITICAL-MASS DATA. H. C. Paxton (Los Alamos Scientific Lab., N. Mex.). Apr. 1964. Contract W-7405-eng-36. 61p.

Tabulated are critical masses of simple systems, which have been measured at Los Alamos through the year 1963. (auth)

Direct Energy Conversion

Refer also to abstract 24857.

24350 (AD-418276) ADDITIVE CONVERTER STUDIES. Quarterly Report No. 3. S. S. Kitrilakis (Thermo Electron Engineering Corp., Waltham, Mass.). Sept. 1963. Contract AF33(657)-10130. 22p.

A Re emitter–Mo collector converter was tested with Cs and CsF additive. The most significant effect of the CsF is a lowering of the collector work function by 0.1 to 0.15 volts. This collector work function reduction is evident in retarding plot measurements and in the increase of the output voltages at the knee of current-voltage curves. The effect of the additive on the work function of the emitter has not been clearly formulated. Under conditions of high-power output the emitter work function appears unaffected. At lower Cs pressures, however, an increase in work function is observed for high CsF arrival rates, while low CsF arrival rates result in work functions lower than the Cs-only case. A Re emitter–Mo collector converter was operated for 150 hours with Cs and CsF additive and then subjected to metallurgical examination. The emitter, collector and seal structures were examined and no corrosion attributable to the presence of CsF was detected. (auth)

24351 (AD-427285) HIGH-TEMPERATURE THERMOELECTRIC RESEARCH. Quarterly Progress Report No. 1, September 15–December 31, 1963. C. M. Henderson (Monsanto Research Corp. Dayton Labs., Ohio). Contract AF33(615)-1084. 69p.

The technical feasibility of utilizing high-temperature thermoelectric generators, powered with nuclear and solar heat sources, for long-lived power supplies for aerospace vehicles is studied. A 50-watt laboratory generator, fabricated of segmented thermoelements and preliminarily tested, was subjected to sustained testing with its hot-junction 1215°C, its cold junction 570°C and in a vacuum of 10^{-5} to 10^{-6} Torr. This generator exhibited a 12.8 watt/lb performance ratio at an overall thermal efficiency of 2%. At the end of 266 hr continuous performance, an unstable power output condition of the generator halted the test. Investigation of the causes of the unstable power output showed that the intermediate junction design temperature of the segmented n-type thermoelements used in the generator had been exceeded by about 100°C. No damage to the high temperature (850 to 1200°C) thermoelectric segments or junction materials was sustained. Plans were made to repair the damaged generator and to find a way to install temperature monitoring thermocouples at the critical intermediate junction site of segmented thermoelements. The design of an improved experimental generator with a nominal 29 watt(e) output and 15 watt/lb performance is described and results presented on applied research in junction-forming and plasma-spray coating techniques for producing segmented thermoelements. Initial studies of auxiliary power system concepts indicate that, on a minimum-weight basis, a cylindrical generator shape is the most promising for radioisotopes, and that a "fast" reactor is best for a nuclear in-pile or an out-of-pile heat source. (auth)

24352 (ANL-6802) AMU-ANL CONFERENCE ON DIRECT ENERGY CONVERSION, NOVEMBER 4–5, 1963. (Argonne National Lab., Ill.). Dec. 1963. Contract W-31-109-eng-38. 190p. (CONF-414)

Transport properties in ionized gases, fuel cells, thermoelectric devices, solar batteries, plasma diagnostics and thermionics, and energy research and conversion devices were discussed. Separate abstracts are prepared for 16 of the 28 papers presented. Four papers were in summary form; eight papers were previously abstracted in NSA (17: 19442, 18: 14451, 14661, 14776, 14777, 15411, 16745, 16746). (C.E.S.)

For abstracts of individual papers see: 24353, 24354, 24355, 24356, 24357, 24358, 24359, 24360, 24361, 24362, 24363, 24364, 24742, 24743, 24744, and 24745.

24353 (ANL-6802(p.24-5)) SOLAR ENERGY CONVERSION. J. A. Duffie (Wisconsin. Univ., Madison).

Thermoelectric energy converters and photovoltaic processes for solar energy conversion are discussed. (C.E.S.)

24354 (ANL-6802(p.49-52)) LIQUID METAL CELLS. R. E. Henderson (General Motors Corp. Allison Div., Indianapolis).

Potassium-mercury liquid metal cells were studied both theoretically and experimentally. These cells appear to be desirable because they have high heat transfer capability and high current density and are capable of thermal and electrical regeneration. (auth)

24355 (ANL-6802(p.53-63)) HYDRIDE AND BIMETALLIC REGENERATIVE EMF CELLS. M. S. Foster, C. E. Johnson, A. K. Fischer, and C. E. Crouthamel (Argonne National Lab., Ill.).

The design and performance of regenerative lithium hydride cells and bimetallic cells using Li–Te, Li–Bi, Li–Sn, Li–Pb, Li–Zn, and Li–Cd are discussed. (C.E.S.)

24356 (ANL-6802(p.64-5)) PHOTOVOLTAIC ENERGY CONVERSION AND FUEL CELL RESEARCH AT IIT RESEARCH INSTITUTE. John W. Buttrey (Illinois Inst. of Tech., Chicago. IIT Research Inst.).

Several aspects of photovoltaic energy conversion are discussed. The photon absorption constant is plotted as a function of $h\nu$ for Si, Ge, CdTe, and GaAs. Fuel cell development is also considered. (C.E.S.)

24357 (ANL-6802(p.78-86)) THE TEMPERATURE DEPENDENCE OF THE CONTACT RESISTANCE OF AN

IRON PLATED LEAD TELLURIDE CONTACT. G. C. Jain and W. B. Berry (Purdue Univ., Lafayette, Ind.).

The temperature dependence of metal-semiconductor contact resistance is investigated. The contact of particular interest is one of electrodeposited iron on lead telluride. The results of the experimental investigation are presented and followed by the discussion of simple idealized two-carrier models in an effort to explain the experimental results. (auth)

24358 (ANL-6802(p.89-99)) CHARGED PARTICLE PROPULSION: A DOUBLE ENERGY-CONVERSION PROBLEM. Charles D. Hendricks (Illinois. Univ., Urbana).

The nuclear-electrical-mechanical energy conversion problem in charged particle propulsion is discussed. Methods for producing charged particles are considered, and the performance of electrically sprayed liquid droplet sources is described in detail. (C.E.S.)

24359 (ANL-6802(p.101-9)) REVIEW OF MHD POWER GENERATION. W. J. Jackson (Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering and Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics).

The development of MHD power generation during the last six years is reviewed. Several MHD systems are illustrated and described. (C.E.S.)

24360 (ANL-6802(p.126-43)) EXPERIMENTAL DATA FOR ANALYSIS OF THERMIONIC CONVERTERS. D. L. Dresser (General Motors Corp. Allison Div., Indianapolis).

The space-charge, ignited, and arc modes of cesium-filled thermionic converters are discussed. Typical current-voltage characteristics are illustrated. The performance of tungsten and tantalum are described. The design of several research devices is given. (C.E.S.)

24361 (ANL-6802(p.144-51)) EXTENDED SURFACE THERMIONIC CONVERTERS. S. L. Soo and S. G. Quintella (Illinois. Univ., Urbana).

The design and theoretical performance of extended surface thermionic converters are discussed. (C.E.S.)

24362 (ANL-6802(p.152-60)) THERMIONIC ENERGY CONVERSION FOR DC AND HIGH FREQUENCY POWER OUTPUT. Hans K. Richards (Argonne National Lab., Ill.).

The performance of cesium and potassium in thermionic cells for d-c and high-frequency power output is compared. (C.E.S.)

24363 (ANL-6802(p.163-5)) EVALUATING POWER SOURCES. J. McCallum (Battelle Memorial Inst., Columbus, Ohio).

A list of ten characteristics that should be considered in evaluating electric power sources is presented. (C.E.S.)

24364 (ANL-6802(p.166-9)) AN ACOUSTICALLY RESONANT STIRLING ENGINE. R. L. Carter and K. T. Feldman, Jr. (Missouri. Univ., Columbia).

An MHD generator that would produce an alternating current electric output can be realized if a conducting working fluid is made to oscillate in a duct passing transversely through an external magnetic field. One possible means for obtaining an oscillating gas column is provided by the phenomenon of thermoacoustical resonance which utilizes thermal energy to produce an oscillating gas. (auth)

24365 (ASD-TDR-63-37) EXPLOSIVE PARAMETERS FOR MAGNETOHYDRODYNAMIC ENERGY CONVERSION. Final Report, June 24, 1960–July 24, 1963. Marvin W. Burnham (Falcon Research and Development Co., Denver). Sept. 1963. Contract AF08(635)-2918. 78p. (AD-419519)

The explosive charge parameters related to the efficiency and utility of explosive energy sources for pulsed magnetohydrodynamic energy conversion were investigated. Experimental measurements were made of theoretically significant charge geometry and composition parameters. Good agreement with theory was observed and exceptionally high plasma conductivity was measured. A cavity shape, (called the W cavity) tending to produce a tubular conductor, was conceived. Charges designed with such a cavity had a power generation capability over 300% higher than that of charges with conventional cavities. (auth)

24366 (ASD-TDR-63-750) THE DESIGN AND EVALUATION OF PERFORATED ION EMITTERS. E. N. Petrick and J. J. Krauss (Kelsey-Hayes Co., Romulus, Mich.). Sept. 15, 1963. Contract AF33(657)-8638. 32p. (AD-418226)

The feasibility of utilizing emitters of perforated solid sheet rather than a sintered powder structure was investigated with the objective of increasing the reliability and durability of ion engines. Various techniques for drilling micron-size holes in refractory metals were explored. Two of these processes, electron-beam drilling and chemical photo-etching, were used to provide test emitters with hole sizes in the 10-micron range. An electron-beam drilled emitter was Cs flow tested for 83 hours and exhibited, within experimental limits, no discernible change in hole size or flow conductance. In separate tests correlation was made of theoretical and measured flow rates of N and Cs through the emitters. It was determined that the measured Cs flow rate exceeded the theoretically calculable value based on available surface diffusion formulas. (auth)

24367 (GEST-2022) ELECTRICAL INSULATORS AND SPACERS FOR NUCLEAR THERMIONIC DEVICES. L. N. Grossman (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Feb. 1964. Contract NObs-88578. 28p.

Data on the properties of refractory oxides (Al_2O_3, BeO, ThO_2, ZrO_2, and Y_2O_3) applicable to nuclear thermionic devices are reviewed. Vapor pressures, weight loss rates, free energies of formation, Cs and refractory metal compatibility, electric conductivity, thermal expansion, thermal conductivity and mechanical properties are covered. The best values of some properties are presented in both graphical and tabular form. The data were obtained experimentally and from the literature. 44 references. (D.C.W.)

24368 (JPL-TR-32-548) METALLURGICAL EXAMINATION OF DEVELOPMENT-TYPE THERMIONIC POWER CONVERTERS. E. C. Bernett (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Dec. 15, 1963. Contract NAS 7-100. 20p. (N64-13197; NASA-CR-55211)

A number of thermionic power converters (diodes) were examined after they had been tested to failure. Some components of the early-model diodes showed very poor machine finishes; however, there was a noticeable improvement in the later models. The braze joints (particularly the metal–ceramic seal) continue to show a marked variation in structure from model to model, indicating a lack of process control in this area. Heavy foreign deposits were observed on the collectors of two diodes, and there was an intergranular cesium attack on two emitter sleeves. The exact nature of these two effects could not be established, but the evidence indicates they were associated with impurities in the cesium and with poor control of the test atmosphere. (auth)

24369 (NP-13892) THE DEVELOPMENT OF A LOW-TEMPERATURE VAPOR-FILLED THERMIONIC CONVERTER FOR NUCLEAR APPLICATIONS. Summary Technical Report, October 9, 1962—September 30, 1963. W. E. Harbaugh and R. J. Buzzard (Radio Corp. of America. Special Electronic Components Div., Lancaster, Penna.). Jan. 1964. Contract NObs-84823. 204p.

Following the successful operation of the RCA Developmental Type A-1197A converter in a nuclear reactor for more than 300 hours, the work was directed toward four principal objectives: improvement of the A-1197A design; the development of a higher power nuclear-fueled converter; a study of the performance of nuclear-fueled converters connected in series and parallel; and a continued investigation of material properties and converter fabrication techniques. Modifications to improve the performance and extend the life of the A-1197A converter were made on the basis of information obtained in performance and life tests and a detailed computer analysis. A nuclear-fueled converter, the RCA Developmental Type A-1272, was designed. In tests this converter produced more than 10 watts per square centimeter of emitter area. As a result of the experiments with electrically heated converters, the basic principles governing the behavior of series- and parallel-connected converters were defined, mathematical expressions for these basic principles were developed, a method was devised for designing converter systems for use in a reactor, and computer programs were prepared that will predict the performance of such systems of converters. (auth)

24370 (PWA-2337) LIQUID METAL-HEATED SPACE RADIATOR-MOUNTED THERMIONIC GENERATOR. Quarterly Report No. 3, January 1—March 31, 1964. Franz C. Harter (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). Contract AF33(657)-11320. 30p.

Thermionic generators suitable for liquid metal heating in space radiator configurations are evaluated. The thermionic generator incorporates a tantalum alloy liquid metal containment tube insulated from a tungsten—rhenium alloy emitter by beryllia. The collector is made of nickel. The final assembly and initial testing of the generators are reported. At the design emitter temperature, 1500°C, the power output recorded is 5.8 w/cm^2, and the efficiency is 9.7 per cent. The testing uncovered a form of thermal instability due to the effects of electron heating of the collector. (auth)

24371 (RM-3908-PR) THE FISSION-ELECTRIC CELL PROJECT. George Safonov (RAND Corp., Santa Monica, Calif.). Oct. 1963. Contract AF49(638)-700. 178p.

The results of a program to develop direct conversion by fission fragment collection (charging) are presented. Theoretical work, experiments verifying the concept, principles, cell technology, experimental results, and project facilities are covered; and the over-all status of the concept is summarized. (D.C.W.)

24372 (TID-20575) THE FISSION-ELECTRIC CELL PROJECT. A Report on 1963 Operations. Final Report. G. Safonov. Mar. 1, 1964. Contract AT(04-3)-482. 78p.

The ion-type vacuum pump and alloyed magnesium (Dow A3A) cell system employed in the fission-electric cell is described. Irradiation data obtained from 12 variations of the basic system are presented. The 12 test systems were formed by varying magnetron-field profile, cell geometry, and electrode surface conditions. Largely because of the system's advanced surface-vacuum conditions, it generated voltages on the order of 780 volts maximum. Several cell designs consistently reproduced voltages in the 400 to 600 volt range. The system's stability of performance and its high-voltage capability made it possible to determine beyond reasonable doubt: that secondary-ion current cannot be large compared to fragment current under the prevailing surface and electric-field conditions; and that, as a consequence of the particular electric- and magnetic-field profiles at the cell's end zones, voltage was limited by the end-streaming of particles which, by their nature, may be readily controlled by use of standard suppression techniques. Pessimistic extrapolation of data indicates that similar cell-magnetron systems would generate no less than 5000 to 10,000 volts as a result of straightforward modifications which would reduce the flow of such end-streaming particles. Voltage increases, believed attributable to surface conditioning by prolonged irradiation and pumping, were observed. The extreme sensitivity of observed electrical performance to seemingly minor variations in component bakeout time and/or storage history is reported. A correlation between voltages near observed current anomalies, and x-ray excitation energies associated with cell materials is noted. (auth)

24373 GAMMA-RAY IONISATION IN THE PLASMA DIODE. D. Butler. Advan. Energy Conversion, 4: 39-50(Jan.-Mar. 1964).

It is shown that the ionization produced in the interelectrode space of a gas-filled diode by the radiation present in a nuclear reactor is insufficient to produce a useful degree of space-charge neutralization. Consideration is given both to direct gamma-ray ionization of gas atoms and to ionization by fast electrons released from the diode walls by Compton scattering with gamma rays. The latter process produces the larger effect. (auth)

24374 THE MAGNETOHYDRODYNAMIC GENERATION OF POWER. K. Phillips. AEI (Assoc. Elec. Ind.) Eng., 4: 62-7(Mar.-Apr. 1964).

The constant effort to increase the thermal efficiency of electrical generating plant has led to the study of alternative methods of generation. Magnetohydrodynamic generation in which a conducting fluid instead of a solid conductor is passed between the poles of a magnet is one of these methods. Although basically a means of d-c generation, it can be made to generate a-c if more complex equipment is used. The effects of gas conductivity and Hall effect on the output of MHD generators are discussed and their introduction into possible thermodynamic cycles is described. A major problem in the development of these generators is to find suitable materials for use in their construction. The limitations of existing materials are considered. (auth)

24375 THERMIONIC AND MAGNETOHYDRODYNAMIC GENERATORS. NEW ELECTRIC POWER SOURCES. Andrzej Wolkenberg. Przeglad Telekomun., 36: 49-52 (Feb. 1964). (In Polish)

24376 DESIGN OPTIMIZATION OF THERMOELECTRIC DEVICES. F. L. Gray and B. R. West (Texas Instruments Inc., Dallas). New York, Society of Automotive Engineers, 1964, Preprint 842B, 6p. (CONF-505-1)

From Society of Automotive Engineers Air Transport and Space Meeting, New York, Apr. 1964.

A versatile optimization technique for thermoelectric devices is described. The technique is unique because it is equally applicable for either thermoelectric refrigerators or generators. The only variables required for a given design are source and sink temperature, material properties, and application. For any set of conditions, junction temperatures are determined by the simultaneous solution of the energy balance equations at the hot and cold junctions. System design parameters are systematically varied to determine optimum design for maximum coefficient of performance, efficiency, power, or heat pumped per unit cost or weight, or a combination of the above. All relative design parameters such as element geometry, insulation area, and heat transfer to and from the junctions and current are optimized. Two examples, a refrigerator optimized for maximum heat pumped per unit cost, and a generator for maximum power generated per unit cost, are described. Other optimizations are discussed, and variations and refinements of the technique are presented in the conclusions. (auth)

Elementary Particles and Radiations

Refer also to abstracts 23904, 24288, 24508, and 24703.

24377 (AEEW-M-442) A MONTE CARLO COMPUTER PROGRAMME CEP FOR CALCULATING COLLISION PROBABILITIES IN CUBOIDS AND FINITE CYLINDERS. M. E. Gubbins (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Mar. 1964. 10p.

The program CEP which calculates the collision probability P_c for a cuboid or a finite circular cylinder is described. A value of P_c for an infinite cylinder of rectangular cross section can be obtained as a special case of a cuboid. A table of results gives values of P_c obtained by CEP for three types of body—a cube, an infinite cylinder of square cross section, and a finite circular cylinder with height equal to diameter. Approximate formulas for P_c, valid for nearly black bodies, are derived and discussed for the cube and infinite cylinder of square cross section. The values of P_c obtained from these formulas are shown to be in good agreement with the CEP results. The variation of P_c with length for finite circular cylinders is investigated. A semi-empirical formula is given which uses the values of P_c for an infinite cylinder and a cylinder with height equal to diameter to obtain P_c for cylinders of intermediate height to an accuracy of 1%. (auth)

24378 (AEEW-R-326) THE PROGRAMME PIP1 FOR THE SOLUTION OF THE MULTIGROUP EQUATIONS OF THE METHOD OF COLLISION PROBABILITIES. A. J. Clayton (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Mar. 1964. 34p.

The program PIP1, in FORTRAN for the IBM 7090 and 7030, solves the multigroup equations of the method of collision probabilities. The data requirements, the problems that can be solved, and output are described; and the numerical methods used are outlined. The method of solution is basically that of successive over-relaxation. (D.C.W.)

24379 (CONF-510-1) INTERNAL SYMMETRIES. Yuval Ne'eman (California Inst. of Tech., Pasadena). [1964]. Contract AT(11-1)-68. 46p.

From Conference on Symmetry Principles at High Energy, Coral Gables, Fla., Jan. 1964.

Hadron internal symmetries are reviewed. The eightfold way and its applications to strong, electromagnetic, and weak processes, devoting particular attention to new results, are presented. Following a brief review of lepton symmetries, the possible connection between symmetry and dynamics of strong interactions are studied. (L.B.S.)

24380 (DESY-64/3) PHOTOPRODUCTION OF PIONS IN FORWARD DIRECTION AND REGGE POLES. G. Kramer and P. Stichel (Germany. Physikalisches Staatsinstitut, Hamburg). Feb. 1964. 34p.

The photoproduction of single pions on nucleons at high energies and small momentum transfer is considered. The production amplitude is approximated by exchange of ρ-, ω-, φ- and π-mesons in the crossed channel $\gamma + \pi \rightarrow N + \bar{N}$. The mesons are treated either as "elementary" or as Regge poles. The angular distribution is calculated in the high energy limit and is discussed in detail. (auth)

24381 (ISS-64/4) ANALYSIS OF EXCITATION CURVES IN PHOTOPRODUCTION: SEARCH FOR MESONS HEAVIER THAN π MESONS. A. Cacciani and G. Cortellessa (Italy. Istituto Superiori di Sanità, Rome). Mar. 3, 1964. 7p.

A statistical analysis was made of excitation curves of recoil proton photoproduction, using the IBM 610. The results of the analysis show definite evidence, additional to that already given by some authors, for the existence of the ABC anomaly in photoproduction. Some evidence is also shown for η^0, ρ^0, ω^0 photoproduction. (auth)

24382 (JINR-E-1623) ASYMPTOTIC RELATIONS BETWEEN CROSS SECTIONS WITH THE ELECTROMAGNETIC INTERACTION TAKEN INTO ACCOUNT. L. D. Solov'ev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 10p.

It is shown that the ratio of the differential cross sections for particles and antiparticles with strong and electromagnetic interactions taken into account tends to one at high energy if both cross sections are measured with equal (high enough) energy resolutions. It is assumed that at high energy the scattering amplitudes do not oscillate. (auth)

24383 (JINR-E-1646) A CAUSALITY AND DISPERSION RELATIONS. D. I. Blokhintsev and G. I. Kolerov (Joint Inst. of Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 20p.

The analytic properties of the scattering amplitude are studied under the assumption that the signal propagates not only inside the light cone but also outside it, near its surface or its vertex. The conditions of macroscopic causality and spectrality were fulfilled. It is shown that the dispersion relations are violated throughout the energy region. Therefore, a check of these dispersion relations may be of principal importance for the theory. (auth)

24384 (JINR-P-1577) NEUPRUGIE VZAIMODEISTVIYA CHASTITS PRI BOL'SHIKA ENERGIYAKH. (Inelastic Interactions of Particles at High Energies). V. S. Barashenkov, V. M. Mal'tsev, and I. Patera (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 134p.

Experimental data on inelastic particle interactions in the high energy region are reviewed. (auth)

24385 (JINR-P-1593) O VIRTUALYNYKH VOZBUZHDENIYAKH SLOZHNOI CHASTITSY. (On Virtual Excitations of a Compound Particle). B. N. Zakharyev and S. N. Sokolov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 17p.

One-dimensional motion of three interacting particles is considered in the case when two of them form a bound state (compound particle). For the particular case, when the excitation energy of the compound particle grows quadratically the effect of the infinite number of virtual excitations is investigated. It is shown that the population of the higher states is in inverse proportion to the cube of the excitation energy and the neglect of the states higher than the s-th one leads to an error of the order $1/s^3$. It is proved that the equation system that takes into account all the virtual excitations of the compound particle can be solved by the Fredholm method. (auth)

24386 (JINR-P-1598) PROBERKA DISPERSIONNYKH SOOTNOSHENII V OBLASTI MALYKH UGLOV I BOL'SHIK ENERGII. (A Verification of Dispersion Relations in the Small-Angle- and High-Energy Region). V. S. Barashenkov and V. I. Dedyu (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 9p.

Using dispersion relations the real parts of the zero-angle elastic $\pi^{\pm} - p$, $p - p$ and $\bar{p} - p$ scattering amplitudes were calculated with an electronic computer. A comparison of the results of calculations with the well-known experimental data points out that within the accuracy of measurements no essential deviations from dispersion relations are observed in the energy region of $T \leq 20$ Bev, i.e., up to the distances $R = 6 \times 10^{-15}$ cm. (auth)

24387 (JINR-P-1615) POISKI PADIATSIONNYKH RASPADOV REZONANSOV S UCHASTIEM Λ-GIPER. (Search for Radiative Resonance Decays Involving Λ-Hyperons). Yung-chang Wang, Khi In Kim, E. N. Kladnitskaya, G. I. Kopylov, A. A. Kuznetsov, N. N. Melnikova, Din-Ty Nguen, and E. S. Sokolova (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1964. 7p.

Preliminary data on the radiative decays of the resonance systems involving Λ-hyperons are presented. An indication was obtained concerning the existence of the earlier unknown ≈1680-Mev $\Lambda\eta^0$ resonance or a ≈1340-Mev $\Lambda\gamma$ resonance. (auth)

24388 (JINR-P-1616) OB ELEKTROMAGNITNYKH SVOISTVAKH BARIONOV V MODELI UNITARNOI SIMMETRII. (On Electromagnetic Properties of Baryons in the Unitary Symmetry Model). E. Kapustsik and E. Obryk (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 7p.

According to the unitary symmetry model a possibility is considered of an existence of relations between one-baryon matrix elements of the electromagnetic current operator. The physical meaning of the relations earlier established under special assumptions is discussed. (auth)

24389 (JINR-P-1617) IZMERENIE KOEFFITSIENTOV SPINOVOI KORRELYATSII S_{nn} I S_{kp} V UPRUGOM PP-PASSEYANII PRI ENERGII 315 Mev POD UGLOM 45° V S.TS.M. (Measurement of the Spin Correlation Coefficients C_{nn} and C_{kp} in Elastic 315-Mev Scattering at 45° (c.m.s.). Yu. M. Kazarinov, F. Legar, G. Peter, A. F. Pisarev, and K. M. Falybrukh (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1964. 11p.

The spin correlation coefficients C_{nn} and C_{kp} in elastic 315-Mev pp scattering at 45° (c.m.s.) were measured by the spark chamber technique. The coefficients were found to be $C_{nn} = +0.90 \pm 0.51$ and $C_{kp} = +0.74 \pm 0.51$. The phase shift analysis was carried out with the account of the above data. The existence of the first phase shift set obtained earlier is shown to be more probable than that of the second set. (auth)

24390 (JINR-P-1624) O SVOISTVAKH π^0-MEZONOV, OBRAZUYUSHCHIKHSYA V π^0-N I π^--C VZAIMODEISTVIYAKH PRI ENERGII 7.5 Gev. (On Properties of π^0 Mesons Produced in π^--N and π^--C Interactions at 7.5 Gev). V. B. Lyubimov, Mu Chun, and V. N. Streltsov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1964. 9p.

The properties of π^0 mesons detected in the propane chamber by the two absorbed γ quanta were studied. (auth)

24391 (JINR-P-1629) ISSLEDOVANIE γ-KVANTOV, VOZNIKAYUSHCHIKH PRI VSAIMODEISTRII π^--MEZONOV S NUKLONAMI I YADRAMI PRI ENERGII OKOLO 7 Gev. (Investigations of γ-Quanta, Produced in Interactions of π^--Mesons with Nucleons and Nuclei at ≈7 Gev). V. B. Lyubimov, Mu Chun, S. I. Portnova, and V. N. Streltsov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1964. 13p.

On significantly enlarged statistics conclusions obtained earlier were made more precise. Results of the search for multipion resonances of the type $X \rightarrow \pi^{\pm}\pi^{+}\pi^{-}\gamma$, etc., were reported. (auth)

24392 (JINR-P-1632) K DIFRAKTSIONNOMU RASSEYANIYU PROTONOV NA PROTONAKH. (On Diffraction Proton-Proton Scattering). P. Smrzh (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 7p.

A one-meson model was used to calculate the diffraction proton-proton peak by assuming the constancy of the pion-proton peak in the asymptotic region. It is shown that the shrinking of the diffraction proton-proton peak may be also accounted for in the framework of this model. (auth)

24393 (LADC-6357) A MEASUREMENT OF THE NEUTRON-PROTON DEPOLARIZATION PARAMETER AT 23 Mev. R. B. Perkins and J. E. Simmons (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract W-7405-eng-36. 6p. (CONF-502-5)

For Presentation at International Congress of Nuclear Physics, Paris, July 1964.

The neutron-proton depolarization parameter was determined by comparing the scattered neutron polarization to the neutron polarization before scattering. Neutrons of 23.1 Mev and approximately 50 percent polarization were produced in the T(d,n) reaction and were scattered from protons contained in a plastic scintillator. The scattered neutron polarization was analyzed by scattering in a liquid helium scintillator. A triple coincidence between the recoil proton, the recoil alpha particle, and a final neutron detector served to identify the events and to reduce backgrounds to a low level. The values of the depolarization parameter for center-of-mass scattering angles of 70, 90, and 110 degrees were measured to be $+0.56 \pm 0.20$, $+0.81 \pm 0.17$, and $+0.81 \pm 0.20$, respectively. (auth)

24394 (NEVIS-122) AN EXPERIMENTAL STUDY OF PARITY CONSERVATION IN Λ^0 PRODUCTION IN CARBON NUCLEI USING INCIDENT π^- OF 2.0 Bev/c MOMENTUM (thesis). Robert Ehrlich (Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Labs.). Mar. 1964. Contract AT(30-1)-1932. 37p.

Parity conservation was tested for the hyperon (Λ^0) production processes $\pi^- - N \rightarrow \Lambda^0 -$ anything, where the nucleon (N) is in a carbon nucleus. Approximately 120,000 pictures were taken at the Cosmotron of a 30-in. propane bubble chamber exposed to a meson (π^-) beam of 2.0-Bev/c momentum. On the basis of 486 events, of which all but 23 were identified without ambiguity as hyperon (Λ^0), no indication of parity-nonconservation was found. This result rests on the fact that the average hyperon (Λ^0) polarization in the production plane was found to be consistent with the value zero within the statistical error. (auth)

24395 (NP-13872) OSOBENNOSTI PARTSIALNYKH VOLN VBLIZI J = I ASIMPTOTIKI AMPLITUDY UPRUGOGO RASSEYANIYA. (Peculiarities of Partial Waves Near J = 1 and Asymptotics of the Amplitude of Elastic Scattering). V. N. Gribov, I. Ya. Pomeranchuk, and K. A. Ter-Martirosyan (Akademiya Nauk S.S.S.R. Institut Teoreticheskoĭ i Eksperimental'noĭ Fiziki and U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 12p.

The asymptotics of elastic scattering A(st) at s → ∞ was previously determined by the singularities of partial amplitudes fj(t) as functions of the angular moment j. Elastic scattering was analyzed under the assumption that the main contribution is evolved by a vacuum pole with $\alpha(t)$ trajectory at t = 0 passing across the point j = 1. The Mandelstam hypothesis of moving branching points was analyzed for the case $\alpha(0) = 1$, with branching points important to asymptotics. In such a case the condensed branching points converge to a unit and with small t are described by $j_n(t) = 1 + \alpha'(0) \cdot (t/n)$. Partial amplitude singularities described by V. N. Gribov (Zh. Exp. Teoret. Fiz., 41: 667(1961)) were analyzed on the basis of multinominal unitarity terms in the t-channel expanded to complex j. The results confirmed the Mandelstam hypothesis on the presence of $f_j(t)$ singularities in the j plane, while other Mandelstam peculiarities of the type $j = \alpha(\sqrt{t} - \mu)^2 - 1$ at small t do not appear on the nonphysical j plane and do not influence the asymptotics A(s,t). (R.V.J.)

24396 (NP-13947) REPORT ON RECENT EXPERIMENTAL DATA. K. Venkatesan (Institute of Mathematical Sciences, Madras). Feb. 1964. 15p.

The discovery of the Ω^- particle, which according to the SU(3) symmetry scheme of Gell-Mann and Neeman for elementary particles, constitutes together with the N*, Y_1^*, and Ξ^* resonance ($J = 3/2$) the 10-representation. Some details of the experiment and the parameters of the particle are given. Other topics covered are: the experiment of Cocconi et al., on elastic proton-proton scattering at high momentum transfers over a wide range of incident energies; measurements by Foley et al., of the differential cross sections for antiproton elastic scattering from the proton, which indicate no Regge-pole shrinkage, and of the K^+-p elastic differential cross sections, the behavior of which is consistent with such a shrinkage; data on (a) the branching ratios and cross sections for interaction of positive pions with hydrogen at 600-Mev, (b) angular distribution of photoproduced neutral pions, and (c) φ-meson production in pion-nucleon collisions. These subjects were previously included in NSA. (auth)

24397 (NP-13954) DECAY ANGULAR DISTRIBUTIONS OF INTERMEDIATE BOSONS PRODUCED BY PIONS AND BY COLLIDING BEAMS. H. Ueberall (Michigan. Univ., Ann Arbor. Harrison M. Randall Lab. of Physics). [1963]. 25p.

The leptonic decay angular distributions of intermediate bosons are obtained as a possible means of identifying the production reaction; for the latter, the following cases were considered: a) W production by pions on protons (both two-body and inelastic reactions), treated in the peripheral (one pion exchange) approximation, and b) W-pair production in colliding electron-positron beam experiments. The polarization state of the boson is investigated by obtaining the 3 × 3 density matrix, and its connection with the decay angular distributions is noted. (auth)

24398 (NP-13961) NEITRON-NEITRONNE VZAIMODEISTVIE V s-SOSTOYANII. (Neutron-Neutron Interaction in S-State). V. K. Voitovetskii, I. L. Korsunskii, and Yu. F. Pazhin (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 30p.

The upper boundary proton spectrum in D(n,p)2n reactions was investigated in order to determine the neutron-neutron scattering length. Complete deuteron and proton separation was achieved with a scintillation spectrometer. Differential cross sections for corresponding inelastic neutron scattering by deuterons on a Feynman nonrelativistic diagram were used to describe the reaction spectrum. The magnitude $a_{nn} = 23.6^{+1.6}_{-2.1}$ or $e_{nn} = 67^{+12}_{-8}$ kev was obtained by correlation of experimental spectra with the theoretical cross section as a function of proton energy. (tr-auth)

24399 (NP-13966) REPORT ON RECENT EXPERIMENTAL DATA. K. Venkatesan (Institute of Mathematical Sciences, Madras). Mar. 1964. 14p.

Data on electron-proton scattering at high momentum transfers that show no evidence of a nucleon core in the electric or magnetic form factor are reported. The significance of this result is pointed out. The angular distributions or total cross sections for the following reactions are given at various energies: photoproduction of Σ and Λ hyperons, production of the Σ-hyperon, and of η-meson in K^--p interactions; the deuteron Compton effect, and K^--p scattering. In the last case the results show a smooth fall-off of the total cross section with momentum. An event corresponding to pion production in Λ-nucleon collision, observed at Saclay, is also quoted. The branching ratio for the two and three pionic decay modes of the ω-meson and its width are given. An experiment in progress to determine the statistics of the kaon from the spin of the φ-resonance is discussed at some length. An experiment on the precision measurement of the lifetime of muons to test both the CPT theorem and the conserved vector current hypothesis yields a ratio of μ^- to μ^+ lifetime very nearly equal to unity. Some theoretical considerations of Gell-Mann regarding "quarks," the hypothetical building blocks of the observed baryons and mesons, are presented. These subjects were previously included in NSA. (auth)

24400 (NYO-1807-9) THE FORMAL THEORY OF DIRECT-INTERACTION PROCESSES AND SIMPLE APPROXIMATION METHODS. K. R. Greider (Yale Univ., New Haven). [May 13, 1964]. Contract AT(30-1)-1807. 14p. (CONF-396-12)

From the Symposium on Nuclear Spectroscopy with Direct Reactions, Argonne, Ill.).

An attempt is made to justify in a formal way the usefulness and applicability of simple few-parameter models, like the Butler and the Dar models, as well as a new one-parameter model. The deuteron stripping reaction is considered as an example. The usual DWBA formulation is contrasted with the previously-derived formulation $T_{if} = \langle \chi_{np}^{(-)} | t_p' | \chi_n^{(+)} \rangle + \langle \phi_f | V_{np} | \chi_n^{(+)} \rangle$. The latter is found superior when approximation schemes are introduced: (1) both terms may be calculated consistently within the framework of the same approximation; (2) both terms lead to similar angular distributions; (3) cases for a strong Coulomb field between the scattered proton and the core are already naturally described; and (4) calculation without resorting to approximation for the internal deuteron structure is possible. A simple one-parameter stripping theory is derived from just the second term. (M.J.T.)

24401 (NYO-10270) RELATIVISTICALLY INVARIANT POSITION OPERATORS FOR SPINNING PARTICLES. T. F. Jordan and N. Mukunda (Rochester, N. Y. Univ.). June 4, 1963. Contract AT(30-1)-875. 28p.

An examination is made of the consequences for the quantum mechanics of spinning particles of equations characteristic of Lorenz invariant position variables. These equations are commutator analogs of the Poisson bracket equations that express the familiar transformation properties of space-time events in classical mechanics. For a particle of zero spin, it is found that the usual canonical coordinate is the unique solution of these equations. For a particle with positive spin, there is no position operator which satisfies these equations and has commuting components. For a particle and antiparticle there is a unique solution with commuting components, which is valid for all values of the spin and reduces for zero spin to the canonical coordinate and for spin $\frac{1}{2}$ to the Foldy-Wouthuysen transform of the position operator of the Dirac equation. A generalization of the inverse Foldy-Wouthuysen transformation, valid for any value of the spin, appears as a unique unitary transformation that takes this generalized Dirac position to the canonical coordinate. The application of this transformation to the canonical form of the Hamiltonian gives a generalization of the Dirac equation Hamiltonian. This is developed and compared with the literature for spin 1. It gives a nonlocal equation as the spin-1 analog of the Dirac equation. (auth)

24402 (TID-19033) CHARGED SIGMA HYPERON LEPTONIC DECAYS. R. A. Burnstein (Maryland. Univ., College Park and Naval Research Lab., Washington, D. C.); H. Courant (European Organization for Nuclear Research, Geneva); W. Willis, et al. (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT(40-1)-2504]. 12p.

A search for Σ leptonic decays produced in the reaction, $K^- + p \to \Sigma^\pm + \pi^+$, is reported. 21 events of the type $\Sigma^- \to n + \mu^- + \nu$ were observed, and a histogram of the μ^- momentum distribution is presented. The branching ratio $R_-(\mu) = 1.0 \pm 0.04 \times 10^{-3}$ was determined after correction for the effective number of decays. 30 e^- and 3 e^+ events of $\Sigma^\pm \to n + e^\pm + \nu$ decays were observed, and $R_-(e)$ was estimated at $\sim 1.5 \times 10^{-3}$. The branching ratios for 3 $\Sigma^+ \to \Lambda^0 + e^+ + \nu$ and 10 $\Sigma^- \to \Lambda^0 + e^- + \nu$ were found to be $0.6 \pm 0.3 \times 10^{-4}$ and $0.7 \pm 0.4 \times 10^{-4}$, respectively. These values are in reasonable agreement with predicted values. (L.B.S.)

24403 (UCRL-7563-T) DETERMINATION OF THE NUCLEON-NUCLEON ELASTIC SCATTERING MATRIX. I. PHASE SHIFT ANALYSIS OF EXPERIMENTS NEAR 140 Mev. M. H. MacGregor, R. A. Arndt, and A. A. Dubow (California. Univ., Livermore. Lawrence Radiation Lab.). Dec. 6, 1963. Contract W-7405-eng-48. 49p. (CONF-340-16)

From the American Physical Society 1963 Autumn Meeting, Chicago, Oct. 1963.

A phase shift analysis was performed for p-p and n-p experiments near 140 Mev. The two kinds of data were analyzed separately and combined together (with charge-independence assumed). Investigations were made on the accuracy of the data, the significance of error matrix calculations, the significance of the absolute value of χ^2 (the least-squares-sum), and the importance of using an energy-dependence for the phase shifts and for the data. A single solution was obtained that gives a good fit to both the p-p and the n-p data. The gross features of charge-independence were found to accurately verified. Determinations of the π-N coupling constant g^2 and the pion mass gave results consistent with previous N-N analyses. The n-p data, although they include five kinds of experiments, are not complete enough by themselves to permit an accurate phase shift analysis. The p-p data are complete. The combined p-p plus n-p data give T = 1 phase shifts that agree with the phase shifts from the p-p analysis alone, and they give accurate values for the T = 0 phase shifts. 45 references. (auth)

24404 (UCRL-11149) SCATTERING OF 250-Mev POSITIVE Pi MESONS FROM A POLARIZED PROTON TARGET (thesis). Claude Henry Schultz (California. Univ., Berkeley. Lawrence Radiation Lab.). Jan. 17, 1964. Contract W-7405-eng-48. 117p.

The polarization parameter in elastic π^+-p scattering was measured at seven angles at a nominal incident meson kinetic energy of 250 Mev by measuring the asymmetry in scattering from a polarized proton target. The data agree qualitatively with data obtained at 310 Mev by the double-scattering technique. The polarized proton target consisted of a 1-in.^{3} volume of $La_2Mg_3(NO_3)_{12} \cdot 24H_2O$, in which the free protons in the water molecules, comprising 3% of the target by weight, are polarized. The average target polarization during the experiment was 20%, but has since been raised to more than 60%. A description is given of the target design and operation, and formulas are developed for calculating the average target polarization from the output of a nuclear magnetic resonance detector. (auth)

24405 MUON DECAY WITH TWO KINDS OF NEUTRINOS. K. Nagy (Roland Eötvős Univ., Budapest). Acta Phys. Acad. Sci. Hung., 17: 163-9(1964).

The energy spectrum of the electrons originated in the muon decay is calculated by assuming a muon neutrino of nonvanishing rest mass. The change of the spectrum caused by this assumption is also discussed. (auth)

24406 REMARKS ON PION DECAY. K. Nagy (Roland Eötvős Univ., Budapest). Acta Phys. Acad. Sci. Hung., 17: 157-61(1964).

The branching ratio of the decay processes $\pi^- \to e^- + \bar{\nu}$, $\pi^- \to \mu^- + \widetilde{\nu}$ is determined, supposing that $\nu \neq \nu'$ and the muon-neutrino mass $m_{\nu'}$ is different from zero. Numerical values are given for the mass ratios $m_{\nu'}/m_e = 5, 10, 20, 30$, and 40. $m_{\nu'} \sim$ (5 to 10)m_e seems to be compatible with the recent experimental results. (auth)

24407 ON THE PERATIZATION THEORY OF FEINBERG AND PAIS. Mirza A. Baqi Bég (Inst. for Advanced Study, Princeton, N. J.). Ann. Phys. (N. Y.), 27: 183-92(Apr. 1964). (BNL-7468)

An alternate formulation of the peratization program of Feinberg and Pais is presented, and it is shown that the principal results of their theory can be reproduced in a simple manner. Essential use is made of the self-damping of the Fermi interaction in the chain approximation, and of a circumstance that follows therefrom; the existence of a continuously infinite set of theories equivalent in the ladder approximation. While some of the results are more general, the discussion is geared to the case of distinguishable and massless fermions scattering at zero energy. No pretensions are made to mathematical rigor. (auth)

24408 CONTRIBUTION TO THE STUDY OF SPECTRA OF LOW-ENERGY ELECTRONS. José Sant'ana Dionisio

Ann. Phys. (Paris) (13), 8: 747-65(Nov.-Dec. 1963). (In French)

The mechanism of x-ray and Auger transitions is described. Electron binding energy data are reviewed. Selection rules and electromagnetic-transition probabilities lead to the consideration of x- and Auger-radiation width. Various subjects related to the rearrangement of the electronic model—Auger and x-ray intensity, ionization balance as a function of atomic parameters, Auger and Coster-Krönig fluorescent yields—are surveyed. (M.J.T.)

24409 BACKSCATTERING OF ELECTRONS IN THE ENERGY RANGE 4-14 Mev. Shigeru Okabe, Tatsuo Tabata, and Rinsuke Ito. Ann. Rept. Radiation Center Osaka Prefect., 4: 50-4(1963).

The ratios of the number of backscattered electrons to those of primary electrons normally incident on thick targets of Al, Fe, and Pb were measured in the energy range of primary electrons 4 to 14 Mev. The results show that the ratio decreases exponentially with increasing energy in this region. An empirical relation was found that the ratio at an energy E for the target of atomic number Z is approximately equal to the ratio in the kev region for atomic number $Z' = Z/(kE + 1)$, where k is a constant of about 0.6 Mev. The ratio was also investigated in the case of obliquely incident primary electrons on targets of Al and Pb. (P.C.H.)

24410 CONFORMAL SEPARATION OF THE SPIN STATES OF PARTICLES WITH MAXIMUM SPIN 2. Andrei Popovici (C. I. Parhon Univ., Bucharest). Compt. Rend., 258: 3207-9(Mar. 23, 1964). (In French)

Two identities, valid in C_6 for the unified tensors $p^{\pm}_{ab}$, $\varphi^{\pm}_{ab}$ of de Broglie and Dirac, permit, for the nonlinear covariant general conform equations of the particle with maximum spin 2, the separation of the spin states (any eigenmass $M_{5,6}$). For $M_5^2 + M_6^2 \neq 0$, the nonholonomic variety V^4_6 is reduced to V^4_5. (tr-auth)

24411 CALCULATION OF THE COUPLING CONSTANTS OF MESONS WITH THE NUCLEON. Raoelina Andriambololona. Compt. Rend., 258: 3210-11(Mar. 23, 1964). (In French)

The coupling constants of the mesons π, η, ρ, and ω were calculated using the compound meson model as a base. A field of mesons (assumed to be the nucleon field N) of mass m ($m \neq 0$) in interaction with itself is the starting point. The interaction is of the Fermi type. The values calculated are tabulated. (J.S.R.)

24412 SMALL ANGLE SCATTERING OF LOW ENERGY GAMMA-RAYS FROM ATOMIC ELECTRONS. S. Anand, M. Singh, and B. S. Sood (Panjab Univ., Chandigarh, India). Current Sci. (India), 33: 139-40(Mar. 5, 1964).

The total cross sections for gamma scattering at 280 kev from Al, Cu, Fe, and Pb were measured, together with the cross sections for incoherent scattering, at five angles ranging from 4 to 10°. Coherent scattering cross sections were calculated, and the experimental incoherent scattering cross sections were compared with values obtained from the Klein-Nishina formula. Trends in the deviations of the experimental values from the calculated values were observed. The cross sections are tabulated, and an explanation is given. (D.C.W.)

24413 SCATTERING OF PIONS ON PIONS IN THRESHOLD REGION. J. Fischer (Inst. of Physics, Czechoslovak Academy of Sciences, Prague). Czech. J. Phys., 14: 77-88(1964).

It is shown that the integral equations for isoscalar $\pi\pi$-scattering, obtained from the Mandelstam representation by the method of so-called differential approximation, admit the threshold behavior of partial amplitudes, which is in agreement with the quantum theory of scattering and, moreover, they also admit solutions with other possible threshold behaviors. This result does not depend on whether the conformal mapping technique is used or not. (auth)

24414 π-MESON SCATTERING ON NUCLEONS. [PART] II. V. Lelek (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez) and I. Úlehla. Czech. J. Phys., 14: 96-100(1964).

The interaction constants are determined for the interaction of π-mesons and nucleons described by anomalous equations. The experimental data on π-meson scattering on nucleons and the data obtained when studying the shell structure of the nucleus are used. The magnitude of the values found for the interaction constants is acceptable. (auth)

24415 THE LIFETIMES OF CHARGED Σ HYPERONS. B. Bhowmik, P. C. Jain, P. C. Mathur, and N. T. Venkata Lakshmi (Univ. of Delhi). Nucl. Phys., 53: 22-32(Apr. 1964).

An estimate of the lifetimes of Σ^+ and Σ^- hyperons, produced by the interactions of K^- mesons, was made in a nuclear emulsion stack. The best values for the Σ hyperon mean lives are obtained as $\tau_{\Sigma^+} = 0.84 \times 10^{-10}$ sec and $\tau_{\Sigma^-} = 1.63 \times 10^{-10}$ sec. No discrepancy is found between the lifetime values estimated by the rest-flight and the maximum-likelihood methods. The effect of systematic and statistical errors in the energy estimation of the hyperons on the lifetime evaluation by the maximum-likelihood method was investigated. The mass of the Σ^+ hyperon was determined from the weighted mean range 1680.9 ± 3.9 μm, of the proton in the decay mode, $\Sigma^+ \rightarrow p + \pi^0$, at rest and is found to be 1189.45 ± 0.22 Mev. (auth)

24416 THE PHOTODISINTEGRATION OF THE DEUTERON. A. Donnachie (Univ. of London) and P. J. O'Donnell. Nucl. Phys., 53: 128-44(Apr. 1964).

Differential cross sections and polarizations are calculated for photon laboratory energies up to 130 Mev. The calculations are carried out both for a 4 and a 6% deuteron D-state probability, and retardation effects are considered. The final state is described by the Y.L.A.M.-Y.L.A.N. 3M phase parameters of Breit et al., and phenomenological wave functions are used throughout. The results are found not to be sensitive to the deuteron D-state probability, but to depend to a very marked extent on the omission or inclusion of retardation, even at low energies. Detailed comparison with experiment is made, and it is found that the results with 6% deuteron D-state probability, and with retardation included, give a significantly better fit over the whole energy range to the available data, than the other three cases. (auth)

24417 FORWARD PRODUCTION OF PHOTONS FROM 9 Gev π-p INTERACTIONS. G. Backenstoss, J. A. Geibel, B. D. Hyams, W. Maenner, A. Reale, U. Stierlin, and E. Zavattini (CERN, Geneva). Nuovo Cimento (10), 32: 14-17(Apr. 1, 1964).

As a preliminary part of an experiment designed to detect the peripheral production of γ rays in high energy π-p interactions, a measurement of the background of photons from π^0, at very small angles, in the collision of 8.9 Bev/c π^- mesons with H_2 and C is reported. (auth)

24418 PRODUCTION OF TWO CHARGED PIONS IN 871 Mev π^--p INTERACTIONS. W. J. Fickinger, J. G. Mowat, and W. D. Shephard (Univ. of Kentucky, Lexington). Nuovo Cimento (10), 32: 18-24(Apr. 1, 1964).

Double pion production has been observed in 871 Mev π^--p interactions in a hydrogen bubble chamber. A total of 347 events were identified as $\pi^- + p \rightarrow \pi^- + p + \pi^- + \pi^+$ corresponding to a partial cross section of (0.30 ± 0.03) mb. The results are compared to a one-pion-exchange model and to a statistical model with (π^+p) isobar formation. The latter model seems to explain deviations from four-body phase space observed in the experimental distributions. (auth)

24419 PHENOMENOLOGICAL APPROACH TO HIGH-ENERGY LEPTON-NUCLEON SCATTERING. C. Itzykson (Centre d'Etudes Nucléaires, Saclay, France), M. Jacob, and C. H. Chan. Nuovo Cimento (10), 32: 71-89(Apr. 1, 1964).

A comparison is made between two approximations to lepton-nucleon scattering: the conventional one in terms of one-photon exchange using form factors and the extension to this process of the Regge-pole method first suggested for the study of strong-interaction elastic scattering at high energy. The 6 independent scattering amplitudes are calculated using both methods. (auth)

24420 ON THE MASSES AND LIFETIMES OF UNSTABLE PARTICLES. H. P. Stapp (Univ. of California, Berkeley). Nuovo Cimento (10), 32: 103-21(Apr. 1, 1964). (UCRL-10261(Rev.))

Apparent ambiguities of definitions of masses and lifetimes of unstable particles that depend either on the introduction of unperturbed Hamiltonians and their eigenstates, or on an assumed correspondence between resonances and elementary fields, are noted. The S-matrix definition is unambiguous; the positions of poles in the first unphysical sheets are given by the zeros of the Fredholm denominator function, which is a function only of an appropriate center-of-mass energy. The mass and lifetime of a particle are consequently independent of the variables of the scattering process or of the particular process to which the particle contributes. The invariance of the Fredholm denominator under charge conjugation, which is a consequence of CPT invariance, ensures the equality of masses and lifetimes of relativity conjugate antiparticles. Unstable particles are closely akin to stable ones; by the factorization of the residues of unstable-particle poles, unstable-particle scattering functions quite analogous to ordinary scattering functions can be unambiguously defined. Like ordinary scattering functions they are defined only on the mass shell, the fixed masses of the unstable particles being well-defined complex numbers. The needed factorizability of the residue is an immediate consequence of Fredholm's second theorem. The continuation, by means of unitarity, through the multiparticle physical cuts onto unphysical sheets is discussed. (auth)

24421 THE ANALYTIC PROPERTIES OF REGGE TRAJECTORIES. [PART] I. A. E. A. Warburton (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuovo Cimento (10), 32: 122-6(Apr. 1, 1964).

The analytic continuation into each other of the first six Regge trajectories for a repulsive Yukawa potential is demonstrated by numerical integration of the Schrödinger equation for complex angular momentum and energy. The corresponding complex and real branch points are located. (auth)

24422 REMARKS ON THE GENERATORS OF THE SU3 GROUP. P. Jasselette (Université, Liège). Nuovo Cimento (10), 32: 136-40(Apr. 1, 1964).

It is suggested that the sign of the λ_8 matrix among the generators of the SU3 group be changed. The rotation senses around the three axes of the group basic space would thereby be made coherent. Furthermore, various relations, in particular commutation rules, would become symmetrical. Relations between two representations of Weyl's subgroup of SU3 are given. (auth)

24423 PION-NUCLEON COUPLING CONSTANT FROM THE ANALYSIS OF DEPOLARIZATION DATA ON NUCLEON-NUCLEON SCATTERING. R. Cirelli (Università, Milan and Istituto Nazionale di Fisica Nucleare, Milan) and G. Stabilini. Nuovo Cimento (10), 32: 141-7(Apr. 1, 1964).

A search is made of the value of the pion-nucleon constant obtained by extrapolating the quantity $\sigma(1 - D)$ to the one-pion-exchange pole using three different sets of $D(\theta)$ data: Harwell D data at 143 Mev (p-p), Harvard D data at 142 Mev (p-p), and D data by Patel et al. at 128 Mev (n-p). The g^2 value obtained is fairly satisfactory in the first case ($g^2 = 14.86 \pm 2.46$), decidedly bad in the second ($g^2 \simeq 23.23 \pm 4.34$) and, as expected, rather crude in the third ($g^2 \simeq 24.65 \pm 10.97$). (auth)

24424 ON $\pi^\pm$p AND pp ELASTIC SCATTERING. H. Goldberg (Israel Atomic Energy Commission-Soreq Research Establishment, Rehovoth). Nuovo Cimento (10), 32: 148-58(Apr. 1, 1964). (IA-870)

The $\pi^\pm$p and pp elastic differential cross sections are calculated in terms of the T-matrix elements a(JL; E) (for the $\pi^\pm$p case) and a(JLL′; E) (for the pp case). The possibility that the shrinkage of the pp pattern is due to difference in the dependence on the energy of the S = 0 and S = 1 amplitudes is discussed. (auth)

24425 EXISTENCE OF SOLUTIONS OF PARTIAL-WAVE DISPERSION RELATIONS. B. H. Bransden (Univ. of Durham, Eng.) and J. W. Moffat. Nuovo Cimento (10), 32: 159-70(Apr. 1, 1964).

High-energy boundary conditions and the convergence properties and existence of solutions of low-energy partial-wave calculations are studied. The physical significance of the inverse-amplitude solution for low-energy pion-pion scattering is discussed. (auth)

24426 HIGH-FREQUENCY LIMIT OF THE BREMSSTRAHLUNG SPECTRUM. R. T. Deck (Univ. of Notre Dame, Ind.), C. J. Mullin, and C. L. Hammer. Nuovo Cimento (10), 32: 180-97(Apr. 1, 1964). (IS-786)

The bremsstrahlung cross-section at the high-frequency limit of the spectrum was evaluated to the first three nonvanishing orders in αZ for high-energy incident electrons. The power series in αZ which occurs in the cross-section apparently converges rapidly enough to yield accurate results over a wide range of values of Z. The values obtained for the cross-section are somewhat smaller than those predicted by the lowest-order (Fano) theory and are in good agreement with recent experimental measurements. (auth)

24427 ONE-VARIABLE DISPERSION RELATIONS. A. Minguzzi (Università, Bologna). Nuovo Cimento (10), 32: 198-211(Apr. 1, 1964).

With the use of the J.L.D. representation and the infinitesimal completion on the "edge on the wedge" it is proved under the condition of stability of the external particles: (1) The scattering amplitude is the boundary value of a function of energy regular in a neighborhood of the physical range. (2) The scattering amplitude is also the boundary value of a function regular in the external masses, the energy and the momentum transfer being fixed at an arbitrary real value in the physical range. (auth)

24428 Λ^0 POLARIZATION FROM THE REACTION $\gamma + p = K^+ + \Lambda^0$ IN THE ENERGY RANGE (950–1050) Mev. B. Borgia (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome), M. Grilli, P. Joos, L. Mezzetti, M. Nigro, E. Schiavuta, and F. Villa. Nuovo Cimento (10), 32: 218-23(Apr. 1, 1964).

The measurement of the Λ^0 polarization, based on the detection of the proton from the $\Lambda^0 \rightarrow p + \pi^-$ decay mode in coincidence with a K-event, is described and the results are tabulated. The experimental arrangement of the Cherenkov and scintillation counter telescopes is shown. The Λ transverse polarizations are displayed as a function of the incident γ energy. The positive values for the polarization are in this agreement with predictions of some simple theoretical model. (L.B.S.)

24429 CONSIDERATIONS ON THE ISOBAR MECHANISM AND RESONANCE POLES FOR PION–BARYON SYSTEMS. I. P. Gyuk and S. F. Tuan (Purdue Univ., Lafayette, Ind.). Nuovo Cimento (10), 32: 227-33(Apr. 1, 1964).

The Peierls-Hwa theory concerning the generation of higher resonance poles for pion–baryon systems is discussed. The role of a resonance pole involving phase-space factors such that an indirect resonance (Ξ (1745 Mev)) can occur very close to the singularity in the Bohr term is explained. It is indicated qualitatively how the interaction dynamics might intervene to sort out the correct isospin structure for the predicted higher resonances. It is also emphasized that kinematic and mass ratio considerations are especially favorable for the π–Ξ system. (L.B.S.)

24430 REGGE TRAJECTORIES FOR COULOMB POTENTIAL MODIFIED BY INVERSE SQUARE POTENTIAL. C. Marcio do Amaral and Prem P. Srivastava (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Nuovo Cimento (10), 32: 237-8(Apr. 1, 1964).

The trajectories for the singular potential of the form, $Ar^{-2} - Br^{-1}$ (for real A and B), for which an exact solution for the S matrix exists, are discussed. The nth Regge trajectories in the complex s-plane and l-plane are shown. (L.B.S.)

24431 A NOTE ON THE GENERALIZATION OF CHEW'S RECIPROCAL BOOTSTRAP TO SU(3). I. S. Gerstein and K. T. Mahanthappa (Univ. of Pennsylvania, Philadelphia). Nuovo Cimento (10), 32: 239-42(Apr. 1, 1964).

It is shown; by imposing Chew's bootstrap condition and using the crossing matrix for angular momentum, the U-spin crossing matrix, and the eigenvalue λ, to define the residue of the baryon pole; that the generalization of Chew's calculation to SU(3) fails. (L.B.S.)

24432 TRAJECTORIES OF THE RESONANCE POLES IN THE MULTI-CHANNEL SCATTERING AMPLITUDES. T. Kawai and N. Masuda (Tokyo Univ. of Education). Nuovo Cimento (10), 32: 243-7(Apr. 1, 1964).

Using the theory of p-wave two-channel reactions in the chain approximation, it is shown that when there is a resonance pole in the sheet III, reached from the upper half of the physical plane above the threshold s_2, there is always a corresponding pole in the sheet II reached from the upper half of the physical plane between threshold s, and threshold s_2 and that each pole never changes sheets even when the symmetry-breaking interactions are gradually switched off. (L.B.S.)

24433 NONEXISTING REGION OF THE RESONANCE POLES IN THE SCATTERING AMPLITUDES WITH UNSTABLE PARTICLES. T. Kawai and N. Masuda (Tokyo Univ. of Education). Nuovo Cimento (10), 32: 248-52 (Apr. 1, 1964).

The analytic properties of the scattering amplitude including the unstable particles are investigated using the method of multi-channel reactions in the p-wave approximations. The trajectories and the nonexisting region of the resonance poles in the unphysical sheet are determined. (L.B.S.)

24434 A RECALCULATION OF THE GOLDBERGER-TREIMAN FORMULA FOR $\pi^0 \rightarrow 2\gamma$ DECAY. B. G. Smith (Univ. of Sussex, Brighton, Eng.). Nuovo Cimento (10), 32: 253-4(Apr. 1, 1964).

A recalculation of the Goldberger-Frieman formula for $\pi^0 \rightarrow 2\gamma$ decay shows an adjustment of sign in the second term and a difference of a factor $\frac{1}{2}$. The decay width, proportional to the square of $F(-m_\pi^2)$, is plotted as a function of α, the admixture of D-type coupling between baryons and pseudoscalar mesons. (L.B.S.)

24435 ON DEPOLARIZATION OF FAST POSITRONS BY BREMSSTRAHLUNG. S. M. Harris and R. J. Jabbur (Columbia Univ., New York). Nuovo Cimento (10), 32: 258-60(Apr. 1, 1964).

An attempt is made to obtain an estimate of the effect of the bremsstrahlung mechanism in depolarizing positrons from μ^+ decay at extremely high energies. The depolarization due to energy changes of 50 to 10 and 50 to 5 Mev are tabulated for various media. (L.B.S.)

24436 CONSEQUENCES OF A FUNDAMENTAL LENGTH IN VERY-HIGH-ENERGY SCATTERING. R. L. Ingraham (New Mexico State Univ., University Park). Nuovo Cimento (10), 32: 323-55(Apr. 16, 1964).

It is shown that a fundamental length provides the mechanism in quantum field theory to produce the effects noticed in very-high-energy scattering. In the very-high-energy large momentum-transfer (s, $|t| \gg \lambda^{-2}$, $\lambda \equiv$ fundamental length) approximation already semi-quantitative agreement with the following features is obtained. Detailed shape of the elastic scattering curves, including: very sharp forward (and sometimes backward) diffraction peaks with universal exponential tails in t (or u), the flattening and huge experimental shrinking of the diffraction peak with energy of the p-p curves, the weak flattening and absence of shrinking of the π-p curves. Asymptotic constancy of total cross-sections, asymptotic equality of $\sigma_{el}(\pi^- - p)$ and $\sigma_{el}(\pi^+ - p)$, the rough relation $\sigma_{el}(\pi - p) \approx \frac{1}{2}\sigma_{el}(p-p)$. One characteristic of $\lambda \neq 0$ is the rapid vanishing of higher-order corrections at high energies and of radiative corrections at large momentum transfers. With $\lambda = 0$, this is not so, the sharp peaking and exponential tails disappear, and the shrinking of the p-p peak is far too small. An essential dynamical assumption is that a neutral vector meson may be exchanged. These experiments indicate $\lambda \approx 10^{-14}$ cm; the vector meson mass is not yet clear. The fundamental-length field theory used requires an explicit dependence of the S-operator on the measuring frame (frame in which the experiment is performed); it is believed that any relativistically invariant, etc. fundamental-length theory requires this generalization of field theory. This kinematical fundamental-length-theoretic and the dynamical Regge pole explanations of very-high-energy scattering are compared point by point; they are clearly distinguishable at ultra-high momentum transfers. A $\lambda \neq 0$ implies changed asymptotic properties of analytic amplitudes (essential singularities at infinity), thus changes in the physical conclusions derived from dispersion relations. (auth)

24437 THE MASS OF GAUGE PARTICLES AND THE SELF-CONSISTENT METHOD OF QUANTUM FIELD THEORY. S. Kamefuchi and H. Umezawa (Matscience, Inst. of Mathematical Sciences, Madras). Nuovo Cimento (10), 32: 448-68(Apr. 16, 1964).

The self-consistent method based on inequivalent representations is applied to vector fields in order to see whether the so-called gauge theories can allow nonzero masses for gauge vector fields. The Stueckelberg formalism is exclusively used, which is most convenient. It is shown that the representations for vector fields with nonzero mass are inequivalent to those for vector fields with zero mass even when the cut-off momentum and the normalization volume are finite. In quantum electrodynamics it can be shown that the photon cannot have any stable sister particle with nonzero mass. However, it is possible that there exists such a sister particle which is unstable. The consideration is further extended to the Yang-Mills field as a simple example of multiplet gauge fields. It can be shown that the three components of this field cannot have an equal, nonzero mass simultaneously, but that they can have nonzero masses in an asymmetric way such that at least one of the three masses is different from the others. Most conclusions reached here seem to be valid in more general cases of gauge theories. (auth)

24438 UNITARY SYMMETRY AND THE PHOTOPRODUCTION OF η-MESONS. R. F. Dashen (California Inst. of Tech., Pasadena). Nuovo Cimento (10), 32: 469-72(Apr. 16, 1964).

The leading singularities in the amplitude for $\gamma + p \rightarrow \eta + p$ are examined within the framework of unitary symmetry. If some recent ideas about strong interaction symmetries are correct, the cross section for η photoproduction should be an order of magnitude smaller than the cross section for π^0 production. (auth)

24439 DEUTERON ELECTROMAGNETIC FORM FACTORS. M. Gourdin (Laboratoire de Physique Théorique, Orsay, France). Nuovo Cimento (10), 32: 493-4(Apr. 16, 1964).

Previous discrepancies in the calculation of the magnetic deuteron structure function using two different approaches were corrected. (C.E.S.)

24440 A COMMENT ON THE ANALYTIC CONTINUATION OF SCATTERING AMPLITUDES IN THE EXTERNAL MASS VARIABLE. J. Otokozawa (Tohoku Univ., Sendai). Nuovo Cimento (10), 32: 495-7(Apr. 16, 1964).

The analytic continuation of a scattering amplitude in the external mass variable when the intermediate state contains an unstable particle is investigated. The correct prescription for the analytic continuation that gives the necessary unitarity condition in the mass plane is found. (C.E.S.)

24441 PROCESSES FORBIDDEN BY THE G_2 SYMMETRY. Y. Dothan and H. Harari (Israel Atomic Energy Commission, Yavne). Nuovo Cimento (10), 32: 498-9 (Apr. 16, 1964). (IA-908)

The decay processes $\varphi \rightarrow K\bar{K}$, $\Sigma^0 \rightarrow \Lambda + \gamma$, $\eta \rightarrow 3\pi^0$, $\eta \rightarrow \pi^0 + 2\gamma$, $\pi^0 \rightarrow 2\gamma$, $\omega \rightarrow \pi^0 + \gamma$, and $\varphi \rightarrow \pi^0 + \gamma$ that are forbidden in G_2 symmetry are discussed. (C.E.S.)

24442 LIFETIME MEASUREMENT OF Σ^0 THROUGH ITS WEAK INTERACTION. G. Alexander and A. Shapira (Weizmann Inst. of Science, Rehovoth, Israel). Nuovo Cimento (10), 32: 503-5(Apr. 16, 1964).

The possibility of experimentally estimating the Σ^0 lifetime through the ratio $R = \Gamma\ (\Sigma^0 \rightarrow p + \pi^-)/\Gamma\ (\Sigma^0 \rightarrow \Lambda + \gamma)$ using the known Σ^+ and Σ^- decay rates and allowing in addition to the $\Delta I = 1/2$ transition a small contribution from the $\Delta I = 3/2$ transition is considered. (C.E.S.)

24443 MODEL FOR A π-π RESONANCE OF $I = J = 0$. A. N. Mitra (Univ. of Delhi). Nuovo Cimento (10), 32: 506-8(Apr. 16, 1964).

The resonance features exhibited by an apparently repulsive S-wave potential are investigated. It is shown that a previously proposed model for a π-π resonance of $I = J = 0$ need not necessarily be at variance with such a potential. (C.E.S.)

24444 N-D SCATTERING: A SEARCH FOR EFFECTS DUE TO THE DINEUTRON. H. B. Willard, J. K. Blair, and C. M. Jones (Oak Ridge National Lab., Tenn.). Phys. Letters, 9: 339-41(May 1, 1964).

The dineutron threshold anomaly in both the total and scattering cross sections of neutrons by deuterium in the region 2.8 to 3.6 Mev was investigated. 24 references. (R.E.U.)

24445 MEASUREMENTS ON SHORT-RANGE HYPERFRAGMENTS. S. J. Bosgra and W. Hoogland (Universiteit, Amsterdam). Phys. Letters, 9: 345-9(May 1, 1964).

A method used to determine the mutual position of the prongs of a star near the center for short-range (<5 μm) hyperfragments in nuclear emulsions, and capable of detecting double stars with distances between centers of 0.25 μm is applied to hyperfragments produced by 800-Mev/c K^--mesons. (R.E.U.)

24446 NEW EXPERIMENTAL TEST OF THE DECAY RATE PREDICTION, $2\,\Xi_-^- = \Lambda_- + \sqrt{3}\Sigma_0^+$. M. L. Stevenson, J. P. Berge, J. R. Hubbard, G. R. Kalbfleisch, J. B. Shafer, F. T. Solmitz, S. G. Wojcicki, and P. G. Wholmut (Univ. of California, Berkeley). Phys. Letters, 9: 349-51(May 1, 1964).

A prediction by Lee (NSA 18: 10959) that the nonleptonic covariant decay amplitudes for both the S- and P-wave satisfy the relation $2\,\Xi_-^- = \Lambda_- + \sqrt{3}\Sigma_0^+$, using SU(3) symmetry, octet dominance, and R invariance, was investigated by applying experimental data from the reaction $K^- + p \rightarrow \Xi^- + K^+$ to the prediction. (R.E.U.)

24447 DETERMINATION OF THE FORM FACTORS IN $K\mu_3$ DECAYS. N. Cabibbo and A. Maksymowicz (Univ. of California, Berkeley). Phys. Letters, 9: 352-3(May 1, 1964).

The relevance of a measurement of the muon polarization is discussed in the case of completely specified kinematics for the determination of the form factors in $K_{\mu 3}$ decays. The matrix element for $K^+ \rightarrow \mu^+ \nu \pi^0$ is considered in the frame of the V-A theory of weak interactions. (R.E.U.)

24448 POSSIBILITY OF HYPERNUCLEI OF LARGE STRANGENESS. V. I. Ogievetskii and Ting-chang Hsien (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Letters, 9: 354-6(May 1, 1964).

The possible existence of "very strange" hypernuclei is argued based on the extension of the octuplet model of SU(3). (R.E.U.)

24449 THE PRODUCTION MECHANISM FOR THE REACTION $K^+p \rightarrow K^*p$ AT 3 Gev/c. G. R. Lynch, M. Ferro-Luzzi, R. George, Y. Goldschmidt-Clermont, V. P. Henri, B. Jongejans, D. W. G. Leith, F. Muller, and J. M. Perreau (CERN, Geneva). Phys. Letters, 9: 359-62(May 1, 1964).

An analysis was made of K^+-p interactions at 2.60 Bev, which are dominated by $K^+p \rightarrow K^{*+}p$ and $K^{*+} \rightarrow K^0\pi^+$. The angular distributions are consistent with the assumption of vector-meson exchange. (R.E.U.)

24450 QUASIFREE PROTON-DEUTERON SCATTERING CORRECTIONS NEAR 210 Mev. P. F. M. Koehler (Univ. of Rochester, N. Y.), E. H. Thorndike, and Alan H. Cromer. Phys. Rev., 134: B1030-1(June 8, 1964). (UR-875-21)

The results of the impulse approximation formalism of Cromer are applied to proton-deuteron inelastic scattering near 210 Mev to obtain corrections relating measured quasifree P_{pp}, P_{np}, and D_{np} data to the respective free parameters. (auth)

24451 LOW-ENERGY NEUTRON-NEUTRON SCATTERING PARAMETERS. Myron Bander (Stanford Univ., Calif.). Phys. Rev., 134: B1052-7(June 8, 1964). (SLAC-PUB-24)

A precise evaluation of the spectrum in the reaction $\pi^- + D \rightarrow 2n + \gamma$, including final-state interactions, is presented with a view of determining the neutron-neutron scattering length. Approximations of previous calculations are examined and avoided where their effect is found to be significant. Sufficiently accurate experiments should be capable of distinguishing this parameter to an error of 1 F. (auth)

24452 SYSTEMATIC APPROACH TO THE ANALYSIS OF NN AND $N\bar{N}$ TOTAL CROSS SECTIONS. Akbar Ahmadzadeh and Elliot Leader (Univ. of California, Berkeley). Phys. Rev., 134: B1058-62(June 8, 1964). (UCRL-11192; UCRL-11192(Rev.))

A general, rigorous, and extremely simple method of analyzing nucleon-nucleon and nucleon-antinucleon total cross sections is presented. The method is valid for all energies and provides a simple link between the experimental quantities of fundamental physical interest. It is particularly appropriate in the high-energy region and, as an example, is applied to the Regge model. The results are derived by using the concept of crossing and a weak form of Mandelstam analyticity, and depend upon the observation that the NN and $N\bar{N}$ total cross sections can be expressed in terms of a single spin-triplet $N\bar{N} \rightarrow N\bar{N}$ transition amplitude. A basic ingredient is the experimental knowledge of $\sigma_{\bar{p}n}$ or, equivalently, $\sigma_{\bar{n}p}$. A primary aim of this work is to encourage the experimental measurement of these cross sections. (auth)

24453 ELASTIC SCATTERING OF POSITIVE PIONS BY PROTONS IN THE ENERGY RANGE 500-1600 Mev. Jerome A. Helland, Thomas J. Devlin, Donald E. Hagge, Michael J. Longo, Burton J. Moyer, and Calvin D. Wood (Univ. of California, Berkeley). Phys. Rev., 134: B1062-78(June 8, 1964). (UCRL-10378(Rev.1))

Differential cross sections for the elastic scattering of positive pi mesons by protons were measured at the Berkeley Bevatron at pion laboratory kinetic energies between 500 and 1600 Mev. Fifty scintillation counters and a matrix coincidence system were used to identify incoming pions and detect the recoil proton and pion companions. Results were fitted with a power series in the cosine of the center-of-mass scattering angle, and total elastic cross sections were obtained by integrating under the fitted curves. The coefficients of the cosine series are displayed, plotted versus the laboratory kinetic energy of the pion. The most striking features of these curves are the large positive value of the coefficient of $\cos^6\theta^*$, and the large negative value of the coefficient of $\cos^4\theta^*$, both of which maximize in the vicinity of the 1350-Mev peak in the total cross section. These results indicate that the most predominant state contributing to the scattering at the 1350-Mev peak has total angular momentum $J = 7/2$, since the coefficients for terms above $\cos^6\theta^*$ are negligible at this energy. One possible explanation is that the 1350-Mev peak is the result of an $F_{7/2}$ resonance lying on the same Regge-pole trajectory as the $(3/2, 3/2)$ resonance near 195 Mev. (auth)

24454 ELASTIC SCATTERING OF NEGATIVE PIONS ON PROTONS IN THE ENERGY RANGE 500-1000 Mev. Jerome A. Helland, Calvin D. Wood, Thomas J. Devlin, Donald E. Hagge, Michael J. Longo, Burton J. Moyer, and Victor Perez-Mendez (Univ. of California, Berkeley). Phys. Rev., 134: B1079-86(June 8, 1964). (UCRL-10495)

Differential cross sections for the elastic scattering of negative pi mesons on protons $(\pi^- - p \rightarrow \pi^- - p)$ were measured at the Berkeley Bevatron at five laboratory kinetic energies of the pion between 500 and 1000 Mev. The results were least squares fitted with a power series in the cosine of the center-of-mass scattering angle, and total elastic cross sections for $(\pi^- - p \rightarrow \pi^- - p)$ were obtained by integrating under the fitted curves. The coefficients of the cosine series are shown plotted versus the incident pion laboratory kinetic energy. These curves display as a striking feature a large value of the coefficient of $\cos^5\theta^*$ peaking in the vicinity of the 900-Mev resonance. This implies that a superposition of $F_{5/2}$ and $D_{5/2}$ partial waves is prominent in the scattering at this energy, since the coefficients for terms above $\cos^5\theta^*$ are negligible. One possible explanation is that the $F_{5/2}$ enhancement comes from an elastic resonance in the isotopic spin $T = 1/2$ state, consistent with Regge-pole formalism, and the $D_{5/2}$ partial-wave state may be enhanced by inelastic processes. At 600 Mev, the values of the coefficients do not seem to demand the prominence of any single partial-wave state, although the results are compatible with an enhancement in the $J = 3/2$ amplitude. A table listing quantum numbers plausibly associated with the various peaks and "shoulders" seen in the $\pi^\pm - p$ total-cross-section curves is presented. (auth)

24455 ON THE ANALYTIC STRUCTURE OF PRODUCTION AMPLITUDES. Rudolph C. Hwa (Univ. of California, Berkeley). Phys. Rev., 134: B1086-98(June 8, 1964). (UCRL-11168)

The analytic structure of two-particle to three-particle production amplitudes is examined within the framework of analytic S-matrix theory, with particular emphasis on the structure of the physical sheet. The basic principle used is maximal analyticity, which is both discussed and exemplified. The knowledge of the structure of the physical sheet is used in deriving formulas for the discontinuities across the cuts in the two-particle subenergies of the three-particle channel and across the cut in the total energy. (auth)

24456 USE OF THE ρ-PHOTON ANALOGY IN A MODEL OF ISOBAR PRODUCTION. Leo Stodolsky

(Univ. of Chicago). Phys. Rev., 134: B1099-1110(June 8, 1964).

A model for the production of isobars by the exchange of a spin-1 meson is presented. The production of the $N^*(1238)$ and $Y^*(1380)$ $P_{3/2}$ isobars by π, K^+ and K^- mesons by the exchange of ρ or K^* is discussed. The vertex $\rho + N \rightarrow N + \pi$ or $\bar{K}^* + N \rightarrow \Lambda + \pi$ is treated by assuming a magnetic dipole transition ($M1 \rightarrow P_{3/2}$) in analogy with virtual photoproduction (electroproduction). This assumption then leads to a prediction for the decay distribution, the over-all production distribution, and the mass distribution of the isobar with no free parameters. This description is found to be in agreement with experiment in a variety of cases, although to obtain quantitative agreement with the production angular distributions at higher energies a form factor must be assumed to give sufficient backward peaking for the isobar. It is further shown how the absolute cross section for isobar production by this mechanism may be found in terms of the photoproduction cross section by assuming the "ρ-photon analogy" (i.e., total ρ dominance of isovector photon interactions) which at zero momentum transfer reads $(1/e)\langle J_\mu \gamma^v \rangle = (1/f_\rho)\langle J_\mu \rho \rangle$. The resulting number is reasonable as far as order of magnitude is concerned. To make a quantitative comparison with experimental cross sections, the reaction $K^+ + P \rightarrow N^{*++} + K^0$, where some detailed information exists, is examined. The value of the ρKK coupling needed here is found in terms of the known $\rho\pi\pi$ coupling by assuming universal coupling of the ρ to the isospin current. The resulting theoretical cross section is found to be too small by roughly a factor of six at 910 Mev/c and in rough agreement within theoretical uncertainties at 1.4 and 1.96 Bev/c if the effect of the form factor in reducing the cross section is taken into account. Formulas for the decay of an arbitrary isobar excited by spin-1 exchange and a test for spin-1 exchange are given. Production of ω^0 with N^* is discussed and a brief treatment in terms of N^* as a spin-$^3/_2$ particle is given. (auth)

24457 K-N INTERACTION IN THE I = 0 STATE AT LOW ENERGIES. V. J. Stenger (Univ. of California, Los Angeles), W. E. Slater, D. H. Stork, H. K. Ticho, G. Goldhaber, and S. Goldhaber. Phys. Rev., 134: B1111-23 (June 8, 1964).

The study of the I = 0, K-N interaction at low energies using K^+-deuterium scattering was extended on the experimental side by the inclusion of elastic and inelastic noncharge-exchange scattering, and on the theoretical side by a more detailed investigation of the final-state interaction between the two nucleons. The new results for the I = 0 phase shifts exhibit the same trends as those published before; however, the new s-wave data are more accurate. It is shown that at very low energies, the I = 0 s-wave scattering may be interpreted as due to a very small scattering length $A_0 = +0.04 \pm 0.04$ fm. This should be contrasted with the I = 1 scattering length $A_1 = -0.31 \pm 0.01$ fm. (auth)

24458 BOUND STATES AND ELEMENTARY PARTICLES IN THE LIMIT $Z_3 = 0$. M. L. Whippman and I. S. Gerstein (Univ. of Pennsylvania, Philadelphia). Phys. Rev., 134: B1123-7(June 8, 1964).

The limit $Z_3 = 0$ is studied in the Zachariasen model using dispersion theory techniques. The connection between bound states and elementary particles is demonstrated in this limit and it is shown how Castillejo-Dalitz-Dyson ambiguities are removed. (auth)

24459 S-WAVE Λ-Λ INTERACTION FOR ODD Σ-Λ PARITY. John Pappademos (Univ. of Chicago). Phys. Rev., 134: B1128-31(June 8, 1964).

The $^1S_0$ Λ-Λ zero-energy scattering length is calculated by solving the Schroedinger equation for the coupled Λ-Λ and Σ-Σ channels, using pionic exchange potentials (with hard core of radius x_0) derived for the case of odd Λ-Σ parity. Using the value of x_0 and the coupling constants $f_{\Sigma\Sigma}$ and $g_{\Lambda\Sigma}$ which fit the low-energy Λ-N scattering data, the Λ-Λ interaction is found to be so strongly attractive as to bind in the $^1S_0$ Λ-Λ state. Since the Λ-Λ interaction deduced phenomenologically from the analysis of Λ-Λ hypernuclei is not strong enough to bind, it is concluded that the assumption of odd Λ-Σ parity leads to contradictory results in the calculation of the low-energy Λ-N and Λ-Λ scattering. (auth)

24460 LOW-ENERGY Ξ-N INTERACTIONS. John Pappademos (Univ. of Chicago). Phys. Rev., 134: B1132-7 (June 8, 1964).

The fraction $R_{\Lambda\Lambda} = \Lambda/(\Xi^0 + \Lambda)$ in the reactions $\Xi^- + p \rightarrow \Lambda + \Lambda$ and $\Xi^- + p \rightarrow \Xi^0 + n$ is calculated as a function of the $\Xi^- - \Xi^0$ mass difference and the coupling constant combinations allowed by the octet model, by solving the Schroedinger equation for hard-core potentials together with contributions from pion, kaon, and K^* exchange. If $f = F/(D + F)$ in the mixture of the F- and D-type couplings between the baryons and the pseudoscalar mesons, then, using F-type $K^*\Lambda N$ and $K^*\Lambda\Xi$ couplings, it is found that $R_{\Lambda\Lambda}$ lies in the range 0.01 to 0.15 for $0 \leq f \leq 0.45$, increasing rapidly toward unity as $f \rightarrow 0.5$. Calculations of the effect of the closed Ξ-N channel on the low-energy $\Lambda - \Lambda$ scattering show that this is a very small effect. (auth)

24461 CORRELATION EFFECTS IN MANY FERMION SYSTEMS. II. LINKED CLUSTERS. Hugh P. Kelly (Univ. of California, La Jolla). Phys. Rev., 134: A1450-3(June 15, 1964).

A set of coupled equations was previously derived for the ground-state wave function and energy of a finite system of interacting Fermions. The equations are modified so as to be more applicable to systems in which the number of particles becomes large. The resulting equations are shown to be equivalent to those obtained from many-body perturbation theory. (auth)

24462 MEASUREMENT OF THE nn SINGLET S-STATE SCATTERING LENGTH. James W. Ryan (Univ. of Rochester, N. Y.). Phys. Rev. Letters, 12: 564-6 (May 18, 1964).

The γ spectrum from the reaction $\pi^- + d \rightarrow n + n + \gamma$ was measured. A comparison with folded theoretical spectra for various values of the n-n scattering length is made. (M.J.T.)

24463 NEUTRAL DECAY AND ISOTOPIC SPIN OF THE f^0. N. Gelfand (Columbia Univ., New York). G. Luetjens, M. Nussbaum, et al. Phys. Rev. Letters, 12: 567-8 (May 18, 1964).

The production and decay of the f^0 meson were studied in π^+-meson interactions with dueterons. The essential process studied is $\pi^+ + n \rightarrow p + f^0$, $f^0 \rightarrow \pi^+ + \pi^-$ or $f^0 \rightarrow 2n\pi^0$, $n = 1, \ldots 4$. The relative probability of the neutral decay is 0.6. It is found that f^0 has isospin zero. A distinction between f^0 decay and B $(\omega^0 + \pi^0)$ decay is discussed. (M.J.T.)

24464 RADIATIVE CORRECTIONS TO ELECTROMAGNETIC MOMENTS AND LEPTONIC DECAYS OF THE INTERMEDIATE BOSON W. T. D. Lee (Columbia Univ., New York). Phys. Rev. Letters, 12: 569(May 18, 1964).

It is assumed that the zeroth order gyromagnetic ratio of the vector charged intermediate boson $W^{\pm}$ is $(1 + \kappa)$, with $\kappa = 0$. Thence radiative corrections to the various electromagnetic moments and the leptonic decay modes of $W^{\pm}$ are calculated. (M.J.T.)

24465 MESON–BARYON RESONANCES IN U(3) ⊕ U(3) SYMMETRY. I. S. Gerstein and K. T. Mahanthappa (Univ. of Pennsylvania, Philadelphia). Phys. Rev. Letters, 12: 570-1(May 18, 1964).

Meson-baryon resonances are discussed in the framework of U(3) ⊕ U(3) symmetry. The basic fields are taken to be U(3) triplets ψ and V. Hypercharge is assigned and the baryons, pseudoscalar and vector meson, and meson-baryon resonances are constructed using these fields. Mass formulas for the meson-baryon resonances are found; 18 resonances are predicted, all with $J = {}^3/_2{}^+$. (M.J.T.)

24466 EVIDENCE THAT THE f^0 HAS ISOTOPIC SPIN ZERO. G. Benson, L. Lovell, E. Marquit, B. Roe, D. Sinclair, J. Vander Velde, and K. Weaver (Univ. of Michigan, Ann Arbor). Phys. Rev. Letters, 12: 600-2(May 25, 1964).

The results of an analysis of 3.65-Bev/c π^+ in deuterium, along with results of a similar $\pi^- - p$ exposure, show that the f^0 is $(J = \text{even})^{++}$ $(T = 0)$ and cannot, therefore, be identified with the ω-π resonance (B meson). Evidence is obtained from an analysis of the invariant-mass distribution of the "neutrals" from the reaction $\pi^+ + n + (p) \rightarrow (p) + p +$ neutrals and the $\pi^+\pi^-$ mass distribution from the reaction $\pi^+ + n + (p) \rightarrow (p) + p + \pi^+ + \pi^-$. (L.B.S.)

24467 SOME REMARKS ON THE LIFETIMES OF THE MASSIVE TRIPLETS. Paolo Franzini (Brookhaven National Lab., Upton, N. Y.) and Juliet Lee-Franzini. Phys. Rev. Letters, 12: 602-3(May 25, 1964).

The consequences of abandoning the hypothesis that the electromagnetic and weak interactions transform like some components of the eight-dimensional representation of SU(3) is discussed, and it is shown that the lifetime of α and β decays is extremely sensitive to the nature of the interaction. (L.B.S.)

24468 THE NUMERICAL EVALUATION OF THE CLASSICAL ANGLE OF DEFLECTION AND OF THE J.W.K.B. PHASE SHIFT. F. J. Smith (Queen's Univ., Belfast). Physica, 30: 497-504(Mar. 1964).

Numerical formulas are derived for the classical angle of deflection, χ, and for the JWKB approximation to the phase shift, η. Based on Gauss-Mehler quadratures, these formulas are in general more accurate and simpler to use than other formulas for χ and η. (auth)

24469 THEORY OF THE μ-MESON. Ivan Ulehla. Rozpravy Cesk. Akad. Ved, Rada Mat. Prirod. Ved, 73: No. 5, 1-34(1963).

Equation for the free μ-meson are discussed with and without the introduction of electromagnetic interaction. The properties of the μ-meson are described using equations other than Dirac equations. (R.E.U.)

24470 ON THE POLES OF THE GENERATION AMPLITUDE FOR THE PROCESS $\pi + d \rightarrow d + \pi + \pi$. V. I. Fushchich (Inst. of Mathematics, Kiev). Ukr. Fiz. Zh., 9: 117-21(Feb. 1964). (In Ukrainian)

The contribution poles in the generation amplitude is studied from the diagrams of the drawing, as well as from diagrams obtained from the diagrams of the drawing by transposing the external meson lines, for the process $\pi + d \rightarrow d + \pi + \pi$ in respect to the invariant t_{13}. Values are found for other invariants (s_{12}, s_{34}, s_{45}, and t_{25}) with which the poles lie close to the physical region. (auth)

24471 ASYMPTOTIC BEHAVIOR OF THE PION FORM FACTOR AT HIGH TRANSMITTED IMPULSES. B. I. Kolodii (Lvov Polytechnical Inst.). Ukr. Fiz. Zh., 9: 122-7(Feb. 1964). (In Ukrainian)

Restrictions of the behavior of the pion electromagnetic form factor are found by means of the theory of singular integral equations, experimental data on the isotopic vector part of the nucleon electromagnetic structure and an estimate of the behavior of the amplitude $N\overline{N} \rightarrow \pi\pi$ at high energies. (auth)

24472 LINEARIZATION OF THE DIFFERENTIAL SCATTERING CROSS SECTION IN PHASE SHIFT VARIATIONS AND APPLICATION TO RESEARCH ON PHASE SHIFTS. Micheline Musette (Université Libre, Brussels). Univ. Bruxelles, Inst. Phys., Bull., No. 7, 1-14(July 1963). (In French)

A simple way to determine the experimental phase shifts in meson-nucleon scattering is investigated. It consists in the linearization of the differential cross section in the phase-shift variations around some initial values. It is concluded that this method can be useful when the two P-wave phase shifts are appreciably different. (auth)

24473 MEASUREMENT OF THE IONIZING ABILITY OF PARTICLES IN THE SPARK CHAMBER. V. A. Lyubimov and F. A. Pavlovskii. Zh. Eksperim. i Teor. Fiz., 46: 1142-6(Mar. 1964). (In Russian)

The period of the memory cell of a spark chamber with a 30-cm-long gap between the electrodes was measured; it was found that when the chamber was filled with a pure inert gas, the period was relatively long, reaching several tens of microseconds but impurities such as air, propane, or alcohol shortened this time considerably. The high-voltage discharge in a chamber filled with He + 1% air was found to depend greatly on the time delay involved. It was assumed that there is a correlation between the structure of the discharge and the ionizing ability of the particles. Admixture of electronegative gases caused a decrease of the ionization density while addition of multiatomic gases resulted in the extinction of the photon discharge mechanism, slowing down the process. In order to verify the assumptions, the ionizing ability of the gases was measured, making use of protons and π mesons in chambers filled with Ne + 0.03% propane under a pressure of 540 mm of Hg. The ionizing ability of the particles could be derived on the basis of the varying brightness of the tracks. Previously J. W. Cronin (Nucl. Instr. and Meth. 20: 143(1963)) and C. T. Coffin (Ibid. 20: 156(1963)) made such observations, finding that proton tracks exhibited greater brightness than π-meson tracks, while studying the decay of λ particles in a multilayer spark chamber. (TTT)

24474 THE PROBLEM OF DETERMINING THE NATURE OF THE LOW-ENERGY INTERACTION OF π MESONS ON THE BASIS OF THE $p + d \rightarrow {}^3He + 2\pi$ AND $\pi + N + 2\pi$ REACTIONS. V. V. Anisovich and L. G. Dakhno (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksperim. i Teor. Fiz., 46: 1152-5(Mar. 1964). (In Russian)

Data on low-energy interactions of π mesons were found to lead to contradictory conclusions. Study of the energy spectrum of ${}^3He$ in the $p + d \rightarrow {}^3He + 2\pi$ reaction revealed an energy distribution maximum, which was attributed to the large scattering length of the π mesons. Indications of a strong interaction at low energies were found in the $\gamma + p \rightarrow p + 2\pi$ and the $p + \overline{p} \rightarrow 6\pi$ reactions; however in the $\pi + N \rightarrow N + 2\pi$ reactions no resonance interaction of the π-mesons was observed. The study revealed that the divergence in the energy distribution as a function of $\sqrt{s}$, where $\sqrt{s}$ is the total energy of the π

mesons formed in their center-of-mass system, at $\sqrt{s} = \sim 2$ in the p + d → ^{3}He + 2π and π + N → N + 2π reactions may be due to logarithmic singularities at the amplitudes of their generation. In the latter reaction the logarithmic singularity was close to the physical region of an incident meson energy from 300 to 600 Mev. The logarithmic singularity could be used to explain the increase in the generation of π mesons at s ≅ 4 in the p + d → ^{3}He + 2π reaction. (TTT)

24475 ABSORPTION OF SLOWED DOWN π^- MESONS IN PROPANE. V. S. Demidov, V. S. Verebryusov, V. G. Kirillov-Ugryumov, A. K. Ponosov, and F. N. Sergeev (Inst. of Engineering Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 46: 1220-5(Apr. 1964). (In Russian)

The energy spectra of secondary singly charged particles produced as a result of absorption of slowed down mesons (π^-) by carbon and also the angular distribution between the prongs in meson (π) stars are obtained with a 4 liter propane bubble chamber. Estimations performed on basis of the energy spectra show that the maximum contribution of the process of meson (π) absorption by a complex consisting of several nucleons (≥4) does not exceed 20%. An analysis of over 200 interactions carried out on an electronic computer by the Monte Carlo method shows that the experimental data are in agreement with the two-nucleon mechanism and, in accordance with preliminary results, the probability for meson (π) absorption by a pair of different nucleons (np) is two or three times greater than that for absorption by a pair of identical (pp) nucleons. (auth)

24476 π-MESON PRODUCTION IN 650 Mev pp-COLLISIONS. V. M. Guzhavin, G. K. Kliger, V. Z. Kolganov, A. V. Lebedev, K. S. Marish, Yu. D. Prokoshkin, V. T. Smolyankin, A. P. Sokolov, L. M. Soroko, and Wa-chuang Tsui (Inst. of Theoretical and Experimental Physics, USSR and Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 46: 1245-56(Apr. 1964). (In Russian)

The angular and energy distributions of mesons (π) and meson = nucleon correlations in meson (π) production by 650-Mev protons were sutided with a liquid hydrogen bubble chamber. The results indicate that the experimental results on the angular distributions of neutral and charged mesons (π) are in agreement with the hypothesis of isotopic invariance. The contribution of the states of the πN-subsystem with an isotopic spin $T_{\pi N} = \frac{1}{2}$ and $\frac{3}{2}$ is measured. The contribution in the latter case is (72 ± 3)%. (auth)

24477 SINGLE-MESON EXCHANGE AND THE ASYMPTOTIC BEHAVIOR OF NUCLEON AND PION SCATTERING ON NUCLEONS. I. A. Kuchin and P. A. Usik (Inst. of Nuclear Physics, Academy of Sciences, Kazakh SSR). Zh. Eksperim. i Teor. Fiz., 46: 1257-65(Apr. 1964). (In Russian)

The properties of the vertex functions for single-meson diagrams of NN and πN interactions are studied. It is concluded that the single-meson approximation is valid in the region of very high energies and that head-on NN and πN collisions do not contribute significantly. (auth)

24478 FOUR AND FIVE PARTICLE PRODUCTION IN HIGH ENERGY ENCOUNTERS. I. A. Verdiev, A. M. Popova, and K. A. Ter-Martirosyan. Zh. Eksperim. i Teor. Fiz., 46: 1295-1306(Apr. 1964). (In Russian)

The asymptotic expressions for the amplitudes of truly elastic processes previously derived are employed for determining the most probable momenta configurations in reactions in which two particles are transformed into four or five at high energies. A general method is proposed for integrating over the momenta (and in particular over the transverse momentum components) of the particles produced in the reactions. A general shape of the energy distribution of the particles is derived. By integrating the distribution it is shown that the total cross sections thus obtained for the indicated reactions are correspondingly proportional to $\xi^{-1} \ln^2\xi$ and $\xi^{-1} \ln^3\xi$. These values are obtained by using the asymptotic amplitude values deduced by taking into account the contribution of only one pole in the j-plane. (auth)

24479 THREE PARTICLE PRODUCTION NEAR THE THRESHOLD WHEN TWO OF THE PARTICLES INTERACT RESONANTLY. V. V. Anisovich and L. G. Dakhno (Ioffe Inst. of Tech., Leningrad). Zh. Eksperim. i Teor. Fiz., 46: 1307-19(Apr. 1964). (In Russian)

The Watson-Migdal formula can be used for analyzing the process of production of three particles near the threshold in the case when two of the particles formed interact in a resonant manner. If the kinetic energy of the produced particles is not large this formula expresses the three particle production amplitude in terms of the threshold energy production amplitude and scattering length of the resonantly interacting particles. Corrections to the Watson-Migdal formula obtained by taking into account the effective radius of the resonantly interacting particles and also nonresonant interaction of the first two particles with the third are considered. The corrections are expressed in terms of the threshold energy three particle production amplitude, effective radius, and scattering lengths of the produced particles. Correction terms for the reaction N + N → N + N + π are considered. (auth)

24480 TRANSITION RADIATION FROM A UNIFORMLY MOVING CHARGE PASSING THROUGH A DIFFUSE INTERFACE BETWEEN TWO MEDIA. A. A. Galeev (Novosibirsk State Univ., USSR). Zh. Eksperim. i Teor. Fiz., 46: 1335-43(Apr. 1964). (In Russian)

The high-frequency part of the spectrum of transition radiation is investigated in the quasiclassical approximation in the case when the characteristic dimension a, over which the dielectric properties of the medium significantly change is much greater than the wave length, $a \gg c/\omega \sqrt{\epsilon}$. For such frequencies the radiation is exponentially small as in the super-barrier reflection effect in quantum mechanics. (auth)

24481 OPTICAL MODEL FOR ANTINUCLEON–NUCLEON COLLISIONS. P. E. Nemirovskii and Yu. F. Strokov. Zh. Eksperim. i Teor. Fiz., 46: 1379-85(Apr. 1964). (In Russian)

The interaction between nonrelativistic antinucleons and nucleons is considered. The interaction can effectively be described by a complex potential which depends on the spin and isotopic spin and contains a tensor force. The results for the total cross sections, elastic scattering angular distributions, and charge exchange cross sections are in satisfactory agreement with the experiments. (auth)

24482 ELEMENTARY PARTICLES. Riccardo Levi-Setti. Chicago Lectures in Physics. Chicago, University of Chicago Press, 1963. 174p.

Properties of elementary particles and invariance laws, classification of elementary particles, interactions, and isotopic-spin and charge independence of elementary particles are discussed. Proton-proton and neutron-proton scattering cross sections, isotopic spin of π mesons, charge independence of π-N interactions, the two-pion system, strange particles, properties of the π- and K-mesons, resonant states of elementary particles, and Regge poles are discussed. Decay selection rules for elementary particles are discussed. (R.E.U.)

Field Theory and Quantum Mechanics

24483 (SUI-63-21) CONTRASTS AND CONFLICTS OF S-MATRIX AND FIELD THEORY. M. Dresden (Iowa. State Univ., Iowa City). June 1963. 48p. (AD-419389; AFOSR-5293)

The framework of the various field theories is outlined briefly. The underlying assumptions of the different field theories are examined. The assumptions made by Stapp ("The Stappian Way") in his axiomatic discussion of S-matrix theory are also reviewed. In addition to a description of the axioms, there are also a number of remarks, comments, and criticisms of these axioms. Special emphasis is given to the similarities and differences between these axioms and the ones adopted in the various versions of field theory. The S-matrix criticism of the notions of usual field theory is reexamined, as is the manner in which the new postulates are supposed to circumvent the field theoretic difficulties. Finally, a number of specific and general questions which pertain to the S-matrix theory are considered. (auth)

24484 (JPRS-24633(p.275-80)) SOME FEATURES OF THE RADIATION FIELD OF A CHARGED PARTICLE IN A MOVING MEDIUM. S. N. Stolyarov. Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 6: 1268-71(Nov.-Dec. 1963).

The potentials of a charge in a moving dispersive medium were calculated, and the zone of formation of the field of the charge in the moving medium was determined. A moving, isotropic electronic plasma was considered as an application of the potential expressions. (D.C.W.)

24485 MODEL WITH SUPERCONDUCTING SOLUTION IN QUANTUM FIELD THEORY II. G. Kuti and G. Marx (Roland Eötvös Univ., Budapest). Acta Phys. Acad. Sci. Hung., 17: 125-55(1964).

The energy spectrum of a self-coupled scalar field with two separate ground states is calculated using the variational method of Ritz. Two types of interacting particles are obtained. Their energies turn out to be finite after a suitable mass renormalization. The possible physical consequences of the model are discussed. (auth)

24486 COMBINED GRAPHICAL PRESENTATION OF THE S-OPERATORS WITH THE QUANTUM-MECHANICAL MANY-PARTICLE PROBLEM. W. Macke and P. Ziesche (Technische Universität, Dresden). Acta Phys. Acad. Sci. Hung., 17: 215-21(1964). (In German)

The S-operator, and also the groundstate Q, E, and the single-particle diffusion function $G(X,X^1)$, of a quantum-mechanical many-particle system $H = H^0 + V$ with quasi-statistical connected and disconnected mutual exchange V were represented in a simple way completely general by only correlated graphs (Compound graphs). (tr-auth)

24487 ON THE ALGEBRAIC STRUCTURE OF GRAVITATIONAL FIELDS ADMITTING OF 5- AND 6-PARAMETER GROUPS OF MOTIONS. H. Światak (Jagellonian Univ., Krakow). Acta Phys. Polon., 25: 161-8(Feb. 1964).

The algebraic structure of gravitational fields admitting of five and six-parameter groups of motions is investigated, a special note being taken of the gravitational fields produced by electromagnetic fields. Applying the modified criterion of integrability of Killing's equations, relations between the algebraic structure of the energy-momentum tensor and that of Weyl's tensor are derived. These show in particular that a zero electromagnetic field produces a gravitational field of type N or 0 whereas a non-zero electromagnetic field gives rise to a gravitational field of type D or 0. It is proved too that in either case Weyl's tensor and the energy-momentum tensor of the electromagnetic field assume the canonical form simultaneously. (auth)

24488 PHONONS FROM A MANY-BODY VIEWPOINT. R. D. Mattuck (Universitet, Copenhagen). Ann. Phys. (N. Y.), 27: 216-26(Apr. 1964).

The phonon is considered as a quasiparticle consisting of an Einstein phonon dressed by interaction with other Einstein phonons. By exact summation of an infinite series of self-energy graphs, the Einstein phonon propagator is evaluated, and its poles yield the well-known phonon dispersion law. An alternative derivation shows the propagator to be also valid in regions of divergence. The vacuum fluctuation diagrams, all of the ring type, are easily summed to get the ground-state energy. The unusual simplicity of the graphs encountered make the arguments here an ideal illustration of the application of the field theoretical technique to the many-body problem. (auth)

24489 QUANTUM STATISTICS OF GASES WITH COULOMB INTERACTION. G. Kelbg (Universität, Rostock, Ger.). Ann. Physik (7), 12: 354-60(Feb. 1964). (In German)

The Slater-sum of an N-particle system with Coulomb interaction was derived. The Coulomb potentials are replaced by effective, or pseudo-, potentials, which are functions of the Planck functional quantum and of the absolute temperature. The pseudo-potentials contain a long-range and a short-range component. The equation characterizing the energy and the state equation of the quantum plasma can be derived from the mathematical techniques employed in classical statistics. The quantum corrections for the Debye-Huckel boundary theorem were derived and discussed. The topics considered have potential applications in the field of the thermodynamics of charged dope nuclei in semiconductors. (auth)

24490 A NEW FORMULATION OF THE RELATIVISTIC WAVE EQUATIONS. David Lovelock (Univ. of Bristol, Eng.). Ann. Physik (7), 12: 361-72(Feb. 1964).

A process of quantization was developed and applied to the equations of motion of those particles that may be regarded as the classical counterparts of the spinning particles of quantum mechanics. By invoking the requirement of uniqueness of rest mass (as exemplified by the Klein-Gordon equation) it was possible to deduce the Dirac and Kemmer wave equations from a common approach. (auth)

24491 PHYSICAL AND PHILOSOPHICAL VIEWS ON THE THEORY OF RELATIVITY. Ragnar Liljeblad. Nucl. Energy, 124-36(May 1964).

The bases, principles, and consequences of special and general relativity are reviewed. The transformation formulas of special relativity and their consequences are also covered, as is the experimental confirmation of general relativity. Some philosophical criticisms of relativity theory are answered. (D.C.W.)

24492 INVARIANT QUANTITIES IN SEMI-SIMPLE GROUPS. [PART] II. M. Umezawa (Institut de Recherches Nucléaires, Strasbourg). Nucl. Phys., 53: 54-64(Apr. 1964).

The investigation of the invariant operators initiated by Racah was extended. A method is described for constructing the fundamental invariants of the unitary unimodular group, introduced by Racah. The eigenvalue of the third order fundamental invariant thus constructed is calculated. Also the relation between the fundamental invariants and the rest of the invariants is discussed. (auth)

24493 A FOLDY-WOUTHUYSEN TRANSFORMATION FOR PARTICLES OF SPIN $^3/_2$. A. D. Bryden (Glasgow Univ.). Nucl. Phys., 53: 165-73(Apr. 1964).

A generalization of the Foldy-Wouthuysen transformation for the Rarita-Schwinger equations for spin $^3/_2$ is given. (auth)

24494 A FOLDY-WOUTHUYSEN TRANSFORMATION FOR PARTICLES OF ARBITRARY SPIN. D. L. Pursey (Glasgow Univ.). Nucl. Phys., 53: 174-6(Apr. 1964).

The generalization of the Foldy-Wouthuysen transformation to the Bargmann-Wigner equations for particles of arbitrary spin is presented. (auth)

24495 A CRITIQUE OF THE SPACE-TIME VARIABLES IN PHYSICAL THEORY. E. Lubkin (Brown Univ., Providence). Nuovo Cimento (10), 32: 171-9(Apr. 1, 1964).

Reasons for seeking to remove the space-time variables from the axioms of physical theory are presented, together with vague glimmerings on how this might be done. (auth)

24496 A SYMMETRY GROUP CONTAINING BOTH THE LORENTZ GROUP AND SU_3. A. O. Barut (Univ. of Colorado, Boulder and National Bureau of Standards, Boulder, Colo.). Nuovo Cimento (10), 32: 234-6(Apr. 1, 1964).

A complex Lorentz group with a real metric in the underlying space is proposed, and its properties are listed. This group, which is different from the complex Lorentz group used in analytical continuation of mass-shell amplitudes, connects space-time and internal quantum numbers. (L.B.S.)

24497 NOTE ON THE FORMULATION OF GAUGE-INVARIANCE CONDITIONS IN S-MATRIX THEORIES. M. E. Mayer (Brandeis Univ., Waltham, Mass.). Nuovo Cimento (10), 32: 317-22(Apr. 16, 1964).

Gauge-invariance of the S-matrix is formulated in terms of a functional derivative condition with respect to a vanishing classical 4-vector field depending on macroscopic space-time co-ordinates (or a family of such fields for the case of non-Abelian gauge groups). This condition can be used to derive identities of the Ward-Takahashi type for the coefficient functions of expansions of the S-matrix in terms of asymptotic field operators. The connection of gauge theories (especially electrodynamics) with macroscopic space-time and with the asymptotic momentum-space behavior of scattering amplitudes is briefly discussed. (auth)

24498 CONFORMAL GROUP IN MINKOWSKY SPACE. UNITARY IRREDUCIBLE REPRESENTATIONS. A. Esteve (Università, Milan and Istituto Nazionale di Fisica Nucleare, Milan) and P. G. Sona. Nuovo Cimento (10), 32: 473-85(Apr. 16, 1964).

The three fundamental series of unitary irreducible representations of the Lie algebra of the conformal group in Minkowsky space are described. The homomorphism between conformal group and the group $G_{2,2}$ of linear transformations which leave invariant the quadratic form $-|z_1|^2-|z_2|^2+|z_3|^2+|z_4|^2$ is used. (auth)

24499 REQUIREMENTS OF SELF-CONSISTENCY IN QUANTUM FIELD THEORIES. D. Flamm and P. G. O. Freund (Univ. of Chicago). Nuovo Cimento (10), 32: 486-92(Apr. 16, 1964).

It is shown that none of the known renormalizable quantum field theories other than quantum electrodynamics of spin-$^1/_2$ fermions is self-consistent in the sense of Baker and Johnson. It is argued that in a self-consistent quantum field theory, all particles lie on Regge trajectories of poles in the complex angular momentum plane, earlier found pathologies being automatically removed by the requirement of self-consistency. (auth)

24500 NON-RELATIVISTIC LIMIT OF COULOMB SCATTERING. G. H. Rawitscher (Yale Univ., New Haven). Phys. Letters, 9: 337-9(May 1, 1964).

Deviations of the Klein-Gordon from the Schroedinger point coulomb cross section were studied, and the effects of the relativistic part of the coulomb interaction on the cross section were investigated. (R.E.U.)

24501 DERIVATION OF GAUGE INVARIANCE AND THE EQUIVALENCE PRINCIPLE FROM LORENTZ INVARIANCE OF THE S-MATRIX. S. Weinberg (Univ. of California, Berkeley). Phys. Letters, 9: 357-9(May 1, 1964).

It is proposed that postulates of gauge invariance and general covariance that are used usually to derive electrodynamics and general relativity are actually unnecessary, because the apparently distinctive features of electromagnetism and gravitation can be deduced from assumptions of the same sort as generally accepted for the strong and weak interactions. Lorentz invariance of the S-matrix, the existence of massless particles of spin 1 and 2, and either the pole structure of the S-matrix or the validity of interaction-representation perturbation theory are assumed. (R.E.U.)

24502 DISTORTED-WAVE BORN EXPANSIONS. Leonard Rosenberg (New York Univ., New York). Phys. Rev., 134: B937-44(June 8, 1964).

A successive approximation procedure is presented for calculating transition amplitudes for direct and rearrangement collision processes. The essential feature of the method is that the base problem about which the solution is expanded exhibits all the bound states (of subsystems of particles), which appear in initial or final scattering states. While no proof is given that our expansion converges, arguments that have been presented indicating that the ordinary Born expansion diverges for a wide class of problems no longer apply to the expansion proposed here. A particular choice of base problem leads directly to the well-known distorted-wave Born approximation. The variational nature of this approximation is exhibited and, as a consequence of the general formalism, a procedure for systematic improvement is presented. Circumstances are described under which the first term in the modified Born expansion has an error of known sign. The use of separable potentials to generate solutions to the base problem is discussed and is shown, in the three-body case, to lead to a model proposed recently by Amado. As a by-product of our work, a variational principle for transition amplitudes is developed that is a generalization of the Kohn principle for the two-body elastic amplitude and is valid for any scattering process described by the Schroedinger equation. (auth)

24503 AHARONOV-BOHM PARADOX. G. T. Trammel (Rice Univ., Houston, Tex.). Phys. Rev., 134: B1183-4 (June 8, 1964).

It is remarked that even in the classical limit the behavior of a charged particle interacting with a stationary current distribution exhibits paradoxical behavior. This comes from the inequality of action and reaction forces. It is shown that the vector potential term appearing in the expression for the canonical momenta represents the electromagnetic field momentum. (auth)

24504 MAGNETIC TRANSLATION GROUP. J. Zak (Massachusetts Inst. of Tech., Cambirdge). Phys. Rev., 134: A1602-6(June 15, 1964).

A group-theoretical approach to the problem of a Bloch electron in a magnetic field is given. A magnetic translation group is defined and its properties, in particular its connection with the usual translation group, are established. (auth)

24505 MAGNETIC TRANSLATION GROUP. II. IRREDUCIBLE REPRESENTATIONS. J. Zak (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 134: A1607-11 (June 15, 1964).

The physical irreducible representations of the magnetic translation group (M.T.G.) defined previously were found. From these a set of solutions of Schrödinger's equation for a Bloch electron in a magnetic field was constructed. In general the M.T.G. is non-Abelian. However, when the magnetic flux through areas enclosed by any vectors of the Bravais lattice become multiples of an elementary fluxon hc/e, the M.T.G. becomes isomorphic to the usual translation group. (auth)

24506 REMARK ON THE EXACT SOLUTION OF THE MASTER EQUATION FOR A MODEL PROPOSED BY JANNER, VAN HOVE AND VERBOVEN. K. Zalewski (Inst. for Chemical Physics, Krakow). Physica, 30: 475-8(Mar. 1964).

The presence of slowly damped oscillations in the Janner, Van Hove, Verboven's strong coupling solution is shown to be a consequence of the Paley-Wiener theorem. The occurrence of similar terms is predicted for arbitrary coupling strength. (auth)

24507 A DERIVATION OF BOLTZMANN'S EQUATION WITH AN ASSUMPTION OF DETERMINACY. [PART] I. G. Ludwig, W. J. C. Mueller, and J. Schroeter (Universität, Marburg, Ger.). Physica, 30: 479-92(Mar. 1964).

A derivation of the classical Boltzmann collision equation is given, proceeding from Boltzmann's original interpretation of the density function f(r,v,t). The essential assumptions together with well known ones, already formulated in other derivations, are that f(r,v,t) is determined by $f(r,v,t-\tau)$ alone (and for instance not only if the whole earlier course in time is given), and that f(r,v,t) proceeds in a determinate manner. (auth)

24508 SYMMETRY AND CONSERVATION LAWS. Eugene P. Wigner (Princeton Univ., N. J.). Proc. Natl. Acad. Sci. U. S., 51: 956-65(May 1964).

Symmetry and invariance considerations in the thinking of early physicists are discussed. The relation between conservation laws and invariance principles are reviewed. The relation between events, laws of nature, and invariance principles are considered. The geometrical and dynamical principles of invariance are outlined. (C.E.S.)

24509 CRITERION OF SIMILITUDE FOR CHARGED PARTICLE MOTION IN ELECTRIC FIELDS. O. Ya. Savchenko. Radiotekhn. i Elektron., 9: 349-51(Feb. 1964). (In Russian)

The theory of similarity for charged particle motion in electric fields was expanded to multicomponent systems. (R.V.J.)

24510 ON "THEORY OF FIELD IN A FIVE-DIMENSIONAL SPACE." Yasuhisa Murai (Saitama Univ., Urawa, Japan). Sci. Rept. Saitama Univ., Ser. A., 4: 37(1961).

A method of developing the five-dimensional formalism is briefly sketched. Adopting the Sakata model and assuming Fermi interactions among nucleons and Λ particles, a formalism which resembles Heisenberg's non-linear field theory is obtained. (L.B.S.)

24511 GYROSCOPE MOTION IN GRAVITATION THEORIES. V. I. Pustovoit and A. V. Bautin (All-Union Inst. of Physics and Tech., USSR). Zh. Eksperim. i Teor. Fiz., 46: 1386-91(Apr. 1964). (In Russian)

Precession of a gyroscope axis in the general theory of relativity is compared with that in linear gravitation theories. The angular velocity of precession in linear theories is found to differ from that in general relativity theory and hence this effect may be a means of differentiating between linear theories and the general theory of relativity. (auth)

24512 QUANTUM SCATTERING THEORY. SELECTED PAPERS. Marc Ross, ed. Bloomington, Ind., Indiana University Press, 1963. 307p.

Quantum mechanics is discussed from the point of view of particle scattering. Five reprints on quantum theory of collision processes, characteristic matrix in elementary particle theory, analytic properties of radial wave functions, variational principles for scattering processes, and the formal theory of scattering are presented. (R.E.U.)

24513 QUANTUM MECHANICS. George L. Trigg. University Physics Series. Princeton, N. J., D. Van Nostrand Company, Inc., 1964. 406p. $9.75.

Mathematical basis, nonrelativistic problems, the Dirac electron theory, and field quantization in quantum mechanics are discussed. Abstract operator methods are stressed. The book is designed for a full year course for graduate students. (R.E.U.)

24514 THE DEVELOPMENT OF WEAK INTERACTION THEORY. P. K. Kabir, ed. International Science Review Series. Volume V. New York, Gordon and Breach Science Publishers, 1963. 308p. $4.95.

A collection is presented of recently published articles tracing the development of weak interaction theory. Approximately 40 articles are reprinted. (R.E.U.)

Geophysics

Refer also to abstract 24790.

24515 (UCRL-11409) DIRECT OBSERVATIONS OF MIRRORING PROTONS IN THE SOUTH ATLANTIC ANOMALY. Harry H. Heckman and George H. Nakano (California. Univ., Berkeley. Lawrence Radiation Lab.). May 5, 1964. Contract W-7405-eng-48. 24p. (CONF-521-1)

From 5th Space Science Symposium, Florence, May 1964.

Nuclear track emulsions recovered from oriented polar-orbiting satellites are being used to carry out a systematic study of the high-energy geomagnetically-trapped protons ($E > 58$ Mev) in the region of the South Atlantic anomaly. Because the trapped protons are detected only at their minimum mirror-point altitudes, they are confined to a plane normal to the local magnetic field. The east-west asymmetry in the flux of trapped protons is observed and measured. From the magnitude of the asymmetry, particle scale heights are determined. At altitudes near 400 km, the measured scale height is $h \approx 70$ km, in agreement with values of scale-heights deduced from model atmospheres when the averaging effects due to the particle's longitudinal drift and mirror oscillations are taken into account. The omnidirectional differential energy spectrum of protons $58 < E < 600$ Mev is found to be similar in shape to previous measurements of the high energy-proton spectra for L values ≤ 1.5. No significant variations in the absolute flux in the energy interval $58 < E < 70$ Mev have been observed during the period Sept. 1962 to Sept. 1963. However, the number of protons per cm^2 we observe indicates that the flux of protons in this energy interval has increased about 4-fold over that observed with Explorer IV (1958). (auth)

24516 (JPRS-24633) IZVESTIYA VUZOV: RADIOPHYSICS. Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 6: 1087-1283(Nov.-Dec. 1963). 309p. (OTS-64-31275)

Separate abstracts were prepared for four of the twenty-six papers included. The other papers deal with antennas, masers, sound reflection, electronic equipment, absorption in the atmosphere, radio emission from the moon, memory devices, and the ionospheric model of Venus. (D.C.W.)

For abstracts of individual papers see: 24252, 24484, 24765, and 24766.

24517 SOME CURRENT VIEWS ABOUT THE IONOSPHERE. L. Thomas (Dept. of Scientific and Industrial Research, Slough, Bucks, Eng.). Brit. J. Appl. Phys., 15: 451-65(May 1964).

During the last decade major advances were made in the knowledge and understanding of the ionized regions occurring at heights above 60 km in the earth's upper atmosphere. These advances have arisen from the wider application of vertical-incidence sounding and other ground-based radio methods of investigation, together with rocket and satellite observations of the solar ionizing radiations, the electron density distribution with height, the ion composition, atmospheric density and other parameters. This information has led to corresponding progress in the development of theories to explain the formation and behavior of the different ionized regions. It is considered that for the greater part of the ionosphere electron production is due to photoionization of atmospheric gases by solar ultraviolet and x radiation, and electron loss is by dissociative recombination of molecular ions. Movements of ionization become more important with increase of height until, eventually, the electron distribution is determined by the diffusion of ions and electrons under the constraining influence of the geomagnetic field. A review of present ideas about the ionosphere is presented, and an attempt is made to point out some of the problems still outstanding. (auth)

24518 ANALYSIS OF SOLAR SITUATIONS PRECEDING THE SUDDEN COMMENCEMENT OF GEOMAGNETIC STORMS. B. Bednarzhova-Novakova (Inst. of Geophysics, Prague). Geomagnetism Aeronomy, 3: 360-4(1963).

Conditions on the solar surface that could be associated with the development of corpuscular streams causing SC storms are analyzed. A study was made of 305 storms during the period 1950 to 1961 with which solar observation data were compared. The results of these comparisons confirm the earlier conclusions that the development of stable corpuscular streams causing SC storms is due to the activity of filaments (prominences). These conclusions agree well with the coronal concept of corpuscular streams. (auth)

24519 THE MECHANISM OF GENERATION OF VERY LOW FREQUENCY ELECTROMAGNETIC RADIATION IN THE EARTH'S OUTER RADIATION BELT. V. Yu. Trakhtengerts (Gorkii State Univ., USSR). Geomagnetism Aeronomy, 3: 365-71(1963).

It is demonstrated that the distribution of electron velocities in the outer radiation belt can be unstable as compared to low frequency electromagnetic oscillations. This instability is presented as an explanation for the origin of a number of peculiarities of very low frequency radiation in the earth's exosphere. (auth)

24520 TYPE-II ABSORPTION AND ITS RELATIONSHIP TO MAGNETIC FIELD DISTURBANCE. N. I. Fedyakina. Geomagnetism Aeronomy, 3: 393-5(1963).

A study was made of type-II absorption on the basis of cosmic noise observational data obtained at Tixie Bay. It was found that during the nighttime hours absorption coincides with negative bays of the H component of the magnetic field at the point of observation. In the morning hours absorption at Tixie Bay is observed simultaneously or with a small lag relative to disturbance of the magnetic field on the nighttime side. (auth)

24521 ULTRA LOW FREQUENCY AURORAL RADIATION. E. A. Ponomarev and E. F. Vershinin. Geomagnetism Aeronomy, 3: 396-404(1963).

Results from observation of ultra-low frequency (ulf) auroral radiation at Tixie Bay are reported. Analysis of these observations leads to the conclusion that the effects of temperature increase in the auroral region, modulation of the light flux from auroras, and cross-modulation can be the result of the effect of ulf waves on the upper atmosphere. An attempt was made to explain the generation and characteristics of ulf on the basis of the concept of auroras being a gas discharge in the upper atmosphere. (auth)

24522 SOME PATTERNS OF BEHAVIOR OF AURORAL HYDROGEN EMISSION. L. S. Yevlashin (Polar Geophysical Inst., Kola Branch, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 405-8(1963).

It is demonstrated that latitude variations of the region of hydrogen emission in auroras $(55-75°\phi)$ are determined both by local time and by geomagnetic activity. The injection of hydrogen atoms associated with auroras can occur on individual days simultaneously in a broad ringlike zone near the zone of maximum frequency of occurrence of auroras. This zone moves over the polar region during the day as a single whole, depending on the position of the earth relative to the sun. (auth)

24523 INFLUENCE OF THE SHORE EFFECT ON THE GEOGRAPHIC DISTRIBUTION OF AURORAL ARCS AND BANDS AS SHOWN BY OBSERVATIONS OF THE RUSSIAN POLAR EXPEDITION OF 1900-1902. Yu. A. Nadubovich. Geomagnetism Aeronomy, 3: 409-17(1963).

An analysis was made of auroral visual observation data obtained along the coast of northern Siberia by the Russian Polar Expedition of 1900 to 1902. It was possible to prepare a detailed map of isochasms showing the complex character of the geographic distribution of auroras. A possible reason for this phenomenon is the earlier discovered shore effect. The increase in the frequency of auroras over the coast averages about 10%. The characteristics of the positions of all auroras reveal a correlative connection with the configuration of the shore line of the continent. The frequency of occurrence of auroras in the zone of their maximum and the position of this zone as revealed by the observations analyzed (at minimum solar activity) agree with earlier published data. (auth)

24524 THE GEOGRAPHICAL DISTRIBUTION OF MAGNETIC DISTURBANCES, RADIO WAVE ABSORPTION AND RADAR ECHOES FROM AURORAS IN THE HIGH LATITUDES. A. P. Nikol'skii. Geomagnetism Aeronomy, 3: 418-22(1963).

Cosmic radio noise observational data for Bjørnøya, magnetic disturbance data for Cape Chelyuskin, and auroral radar echo data for the Bjørnøya area were analyzed. It is shown that three peaks can be found in the diurnal variation of all these phenomena. The conclusion is drawn that in the zone of geomagnetic latitudes 65 to 72° there are three ionized regions controlled by the sun. The hypothesis that there is a diurnal movement of the contact between the outer radiation belt and the upper layers of the earth's atmosphere apparently can explain the appearance of only two peaks during the day in phenomena caused by corpuscular radiation. An explanation of all three peaks can be given if the existence of Störmer corpuscular precipitation curves is accepted. (auth)

24525 SPIRAL DISTRIBUTIONS OF BLACKOUTS AND MAGNETIC ACTIVITY IN THE SOUTHERN HEMISPHERE DURING THE IGY PERIOD. L. A. Yudovich (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, Ussr). Geomagnetism Aeronomy, 3: 423-6(1963).

The data for 14 vertical sounding ionospheric stations at high latitudes of the Southern Hemisphere were used to investigate diurnal variations of the occurrence of blackouts at different seasons of the year during the IGY period. The time of the maximum in the frequency of occurrence of blackouts is characterized by a spiral distribution. A comparison is made with magnetic activity data for Antarctica, as well as with the distribution of blackouts in the Northern Hemisphere. (auth)

24526 MAGNETIC DISTURBANCES AT CONJUGATE POINTS AS A SOURCE OF DATA ON THE UPPER ATMOSPHERE AND SOLAR CORPUSCULAR RADIATION. M. S. Bobrov (Astronomical Council, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 436-42(1963).

The magnetograms for Murchison Bay and Mirny (a pair of conjugate observatories on the polar caps) and magnetograms for Wellen and Macquarie (a similar pair in the auroral zones) were compared in UT for 92 successive days during the IGY (August to October 1958). There was found to be good round-the-clock agreement of the patterns of simultaneous disturbances at Wellen and Macquarie, and good agreement between the diurnal variations of the pattern for Murchison Bay and Mirny with a minimum in the morning hours geomagnetic time. A discussion of these results has made it possible to establish that disruption of agreement between the patterns is due to bombardment of the boundary of the outer atmosphere by solar corpuscular radiation, which exerts a force on the middle of the tube of force connecting Murchison Bay and Mirny through circumterrestrial plasma with a frozen-in magnetic field. This effect is attenuated rapidly with penetration into the depths of the outer atmosphere, and, as a result, the agreement of the patterns for Wellen and Macquarie is not disrupted. The conclusion is drawn that an analysis of magnetic disturbances at conjugate points can supply substantial and systematic information on the outer atmosphere and solar corpuscular radiation. (auth)

24527 THE INFLUENCE OF A LOCAL INCREASE OF CONDUCTIVITY OF THE IONOSPHERE ON S_q VARIATION OF THE EARTH'S MAGNETIC FIELD. K. G. Ivanov (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 443-7(1963).

The problem of disturbances of S_q currents and S_q variation of the earth's magnetic field caused by a local homogeneous increase of ionization density of the E region of the ionosphere is considered. The advantage of this method is that it takes into account the anisotropy of ionospheric conductivity in the earth's magnetic field. Formulas are derived for the current function inside and outside the region of local increase of conductivity at angles of inclination $\sim 90°$. (auth)

24528 GEOACTIVITY AND ITS POSSIBLE CAUSES. V. I. Afanas'eva (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 455-61(1963).

It has long been known that solar activity has an effect on a number of geophysical phenomena. In particular, in geomagnetic phenomena this is manifested in the existence of an 11-year cycle of solar phenomena. It is shown that, in geomagnetic, seismic, and other tetonic phenomena, there is a cyclic regime that is not directly due to solar influences of an electromagnetic character. The conclusion is drawn that this cyclic character of geoactivity is the result of variations of the motion of matter in the earth's core. (auth)

24529 SOME RESULTS OF VISUAL OBSERVATIONS OF AURORAS IN THE NORTHERN HEMISPHERE DURING THE IGY-IGC PERIOD. Ya. I. Fel'dshteyn and N. F. Shevnina (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 547-56(1964).

The analysis of visual observations of auroras at 620 stations in the USSR during the period 1957-1959 is discussed. These stations for the most part are situated in the middle latitudes. The study also uses data on the position of the southern boundary of auroras in the zenith in Europe and America on the basis of data from World Data Centers A and C. (auth)

24530 CLASSIFICATION OF GEOMAGNETIC STORMS USING THE ENERGY CHARACTER FIGURE. V. I. Afanas'eva (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 577-82(1963).

The results are given of a classification of geomagnetic storms during the IGY period using an energy character figure of the form $E = a\delta H_0 + b(\delta H_0)^2$, where δH_0 is the deviation of the field from S_q variations. (auth)

24531 MAGNETIC ACTIVITY AT CONJUGATE POINTS. L. A. Yudovich (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 583-6(1963).

The Q indices of magnetic activity by seasons of the year for the pairs of magnetically conjugate observatories, Mirny-Murchison Bay, Macquarie-Wellen and Macquarie-College, are compared. In the case of the near-polar pair, Mirny-Murchison Bay, the correlation in the nighttime hours is greater than in the daytime hours. Worsening of the correlation in the daytime hours is due to the effect of a solar agent on the outer layers of the magnetosphere; in all probability this agent is the solar wind. The worsening of correlation is asymmetric relative to the midday meridian. (auth)

24532 THE PROPERTIES OF STREAMS OF CORPUSCULAR RADIATION IN AURORAL ZONES. V. I. Pogorelov (Inst. of Physics of the Atmosphere, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 617-18 (1963).

It is found that equations for electron concentration in streams of corpuscular radiation can be rigorously derived. Certain properties of the expression for the law of change of partial pressures, which gives a closed system of basic equations for the electromagnetic field and the parameters of the medium, are noted. (L.B.S.)

24533 LUNAR TIDAL OSCILLATIONS OF CRITICAL FREQUENCIES OF THE E LAYER. V. A. Zagulyaeva (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 619-20(1963).

The results of computations of f_0E tidal oscillations at Ashkhabad are presented. Curves of the dependence of f_0E on sidereal time are presented for Moscow, Tomsk, Irkutsk and Ashkhabad. The amplitudes and phases of the first four harmonics, derived from harmonic analysis of the curves, are tabulated and show a seasonal dependence in lunar oscillations. (L.B.S.)

24534 THE RELATIONSHIP BETWEEN GEOMAGNETIC AND IONOSPHERIC DISTURBANCES AT MIDDLE LATITUDES. M. P. Kiyanovskii and N. V. Mednikova (Moscow State Univ. and Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 622-4 1963).

The degree of relation between geomagnetic and ionospheric disturbances and the time displacement between them are investigated. Parameters based on observations made in Moscow in 1959 are used in the calculations. Geomagnetic activity turns out to be closely related to negative ionospheric disturbances but not to be related to positive disturbances. (M.J.T.)

24535 A STUDY OF EQUATORIAL SPREAD-F. S. Rangaswamy and K. B. Kapasi (All India Radio, New Delhi, India). J. Atmospheric Terrest. Phys., 25: 721-31(Dec. 1963).

Data from seven stations ranging in magnetic dip from 0° to 44°N were analyzed to study night time and seasonal variations of spread-F through nearly half a solar cycle. It is observed that the inhibition of spread-F due to geomagnetic activity is maximum in the equinoxes. In the belt of magnetic dip 0° to 10°, a second peak in the occurrence of spread-F is observed during the night hours. At a typical equatorial station, the occurrence of spread-F is observed to increase with sunspot number. A similar variation is observed in h'F also. At stations with magnetic dip ≥ 18°, the occurrence of spread-F increases with sunspot number in equinoxes, but decreases with sunspot number in summer. A significant lunar variation is observed in the occurrence of equatorial spread-F, which suggests that electrodynamic drift plays a major role in the occurrence of equatorial spread-F. (auth)

24536 SOME PROPERTIES OF RADIO AURORAE IN MEDIUM LATITUDES. K. Sprenger and P. Gloede (Observatory for Ionospheric Research, Kühlungsborn, GDR). J. Atmospheric Terrest. Phys., 26: 193-8(Feb. 1964).

Observations were made on 54 auroral events at Kühlungsborn ($\Phi = 54°$) from 1958 to April 1962 using a 33-Mcps, 10-kw radar with a horizontally rotating antenna. Results are presented concerning the echo geometry; the notably small variations in height of the echoing region; the diurnal, seasonal, and sunspot cycle variations of auroral echo activity; and the correlation with geomagnetic activity. (D.C.W.)

24537 RADIO NOISE FROM THE AURORAL ELECTRONS. [PART] I. R. Parthasarathy and F. T. Berkey (Geophysical Inst., College, Alaska). J. Atmospheric Terrest. Phys., 26: 199-203(Feb. 1964).

Radio emission from auroral electrons in the frequency range from 1 to 7 Mc/s was studied. The emissions were identified as short-duration (1–30 sec) enhancements; they were found to be spread over the entire band without any noticeable peaking near 1.5 Mc/s or the harmonics. It was also found that the direction of radiation approximately coincided with the direction of the visual aurora, as determined from all-sky camera photographs. (auth)

24538 THE DYNAMICS OF THE AURORA. I. INSTABILITIES OF THE AURORA. S.-I. Akasofu and D. S. Kimball (Univ. of Alaska, College). J. Atmospheric Terrest. Phys., 26: 205-11(Feb. 1964).

It is shown that various forms of the aurora result from several active features added to a quiet and homogeneous arc. The development of the additional features, such as the small-scale folding, the large-scale wave, the Ʊ band and the large-scale coiling, is studied in detail. It is pointed out that the space charge instability alone cannot produce the large-scale deformations and that both the space charge instability and hydromagnetic instability play a role in a complicated display. (auth)

24539 A CONTRIBUTION TO THE THEORY OF THE PRODUCTION OF FIELD-ALIGNED IONISATION IRREGULARITIES IN THE EQUATORIAL ELECTROJET. F. B. Knox (Dominion Physical Lab., Lower Hutt, N. Z.). J. Atmospheric Terrest. Phys., 26: 239-49(Feb. 1964).

A theory is developed which shows that, in the presence of crossed electric and magnetic fields, fluctuations of ionization density may increase in amplitude where gradients of mean ionization density or electric field exist. When the theory is applied to the situation occurring in the equatorial electrojet, it predicts the growth of irregularities of ionization density of a type which may have been observed there. The irregularities can occur with wide range of velocity. (auth)

24540 EFFECTS OF DISTANT HIGH ALTITUDE NUCLEAR TESTS ON v.l.f.-PROPAGATION. J. Frisius, A. Ehmert, and D. Stratmann (Max-Planck-Institut für Aeronomie Institut für Stratosphären-Physik, Lindau, Ger.). J. Atmospheric Terrest. Phys., 26: 251-62 (Feb. 1964).

Two high-altitude nuclear tests during October 1962 caused marked deviations from normal vlf propagation conditions, as observed by means of a series of vlf receivers recording simultaneously, at a chain of stations, the field strength of the transmitter GBR (16 kc/s). In both cases, on October 22 at 0441 hours MET, and on October 28 at 0541 hours MET, an abrupt change from normal nighttime propagation to a propagation of pure daytime type occurred for a period of about 0.5 min. The daytime propagation conditions during the following days were obviously altered. The distance of the characteristic field strength minimum moved away from its normal position (at about 490 km from the transmitter), and its shape was deformed. This alteration was observable until a new strong disturbance caused new conditions on November 7. (auth)

24541 SPORADIC-E AND THE EQUATORIAL ELECTROJET. C. S. R. Rao (All India Radio, New Delhi, India). J. Atmospheric Terrest. Phys., 26: 417-27(Mar. 1964).

An analysis of characteristics of sporadic-E at Indian and American equatorial stations was made for quiet and disturbed days during the year 1958. The analysis reveals certain differences between the two chains of stations which indicate a possible difference in the width of the equatorial electrojet at the two zones. In both the annual and seasonal variations on quiet days, values of Es are always higher at Indian stations. Disturbed day value of frequency of disappearance of Es (fEs) is lower than on quiet day. Latitudinal variation of the noon fEs on quiet and disturbed days has been drawn for both the zones and a difference in the two zones found to occur. In addition, it is observed from the superposed epoch method of analysis for disturbed days, fEs shows a drop compared to the quiet day values and the amount of drop is reduced with distance from the magnetic equator. Corresponding dips are found in the values of the horizontal component of the earth's magnetic field. The differences observed in the two zones, possibly due to the effect of the equatorial electrojet are pointed out. The percentage occurrence of Es also shows characteristic diurnal variation in all seasons at the two zones. The latitudinal variation of the percentage occurrence of Es shows considerable differences indicative of a possible difference in the width of the electrojet at the two areas. The variation of noon fEs with sunspot activity for Indian stations shows that there is an increase in fEs with increase in sunspot number. The increase up to a sunspot number of about 100 is not much; but afterwards the rise is fairly rapid and linear up to a very high sunspot number. This is compared with the corresponding f_0F2 variations which show saturation effects after a sunspot number of about 120. (auth)

24542 THE DEVELOPMENT OF THE AURORAL SUBSTORM. S.-I. Akasofu (Univ. of Alaska, College). Planetary Space Sci., 12: 273-82(Apr. 1964).

A working model of simultaneous auroral activity over the entire polar region is presented in terms of the auroral substorm. The substorm has two characteristic phases, an expansive phase and a recovery phase. Each phase is divided into three stages, and characteristic auroral displays over the entire polar region during each stage are described in detail. Further, all the major features seen at a single station are combined into a consistent picture of large-scale auroral activity. (auth)

24543 A COSMOLOGICAL MODEL OF LIGHT PROPAGATION. S. J. Prokhovnik (Univ. of New South Wales, Sydney). Proc. Cambridge Phil. Soc., 60: 265-71(Apr. 1964).

A theory of light propagation consistent with present cosmological views is investigated in the context of a uniformly expanding universe. It leads to the relativistic equivalence of fundamental observers and also provides a natural substratum associated with an observable fundamental reference frame for every locality of the universe. Special relativity emerges as a theory satisfying the observable universe. The model provides a quantitative interpretation of the recent findings in radio and optical astronomy. (auth)

Low Temperature Physics

Refer also to abstract 23524.

24544 (NBS-8253) ON THE CRYOGENIC ASPECTS OF PROJECT SHERWOOD. Seventeenth Progress Report, January 1, 1964 to March 31, 1964. (National Bureau of Standards. Boulder Labs., Boulder, Colo.). Apr. 14, 1964. 6p.

The entire aluminum magnet coil assembly was dunked in LH_2 and potential measurements were made on each pancake at near-zero field. The development of equipment for the measurement of superconductivity is discussed. A thin tin film experiment was modified to allow simultaneous measurement of the resistive transition and the energy gap transition in a magnetic field. A pulsed refrigeration system is being developed for magnet cooling at cryogenic temperatures. (N.W.R.)

24545 A FIELD-THEORETICAL METHOD IN THE THEORY OF SUPERCONDUCTIVITY. A. Zawadowski (Central Research Inst. for Physics, Budapest) and G. Pócsik. Acta Phys. Acad. Sci. Hung., 17: 223-8(1964).

The exact equations concerning the spectral functions of the simplest correlation functions appearing in the theory of superconductivity are derived. As an application it is shown that in the pole-approximation the equations lead to Gorkov's results. (auth)

24546 ENGINEERING WITH SUPERCONDUCTORS. R. Carruthers. Discovery, 25: No. 5, 32-6(May 1964).

Material properties and applications of hard and soft superconductors are discussed. Transformers, power transmission, and the production of magnetic fields are considered. (R.E.U.)

24547 SUPERCONDUCTING MAGNETS AND THE L.1000 CRYOMAGNETIC SYSTEM. M. Wood (Oxford Instrument Co. Ltd., Oxford). J. Sci. Instr., 41: 269-70(May 1964).

The merits and applications of superconducting magnets are briefly discussed, and some Nb−Sn and Nb−Zr magnets displayed at the Exhibition of Scientific Instruments and Apparatus are described. The L.1000 system which comprises all the necessary apparatus for producing a magnetic field with a minimum intensity of 40 kgauss at a cost of 1000 pounds is also described. (D.C.W.)

24548 PERSISTENCE OF SURFACE SUPERCONDUCTIVITY BEYOND H_{C2} IN A TYPE II SUPERCONDUCTOR AS EVIDENCED BY ELECTRON TUNNELING. W. J. Tomasch (Atomics International, Canoga Park, Calif.). Phys. Letters, 9: 104-6(Apr. 1, 1964).

Current-voltage characteristics of tunnel diodes, which were formed by vacuum deposition of thick Pb−Tl films over thin Al films, were studied for parallel and perpendicular magnetic fields. Data obtained from current profile plots at 4.2°K give evidence that surface conductivity persists in the interval $H_{C2} \le H \le H_{C3}$. (L.B.S.)

24549 PERSISTENT CURRENTS IN A ROTATING SUPERCONDUCTOR. D. S. Kothari (Univ. of Delhi). Phys. Letters, 9: 300-1(May 1, 1964).

The measurement of persistent currents in a thin rotating cylindrical superconductors is shown to provide a direct method for the determination of the energy gap. The materials are made superconducting after rotation begins. (R.E.U.)

24550 VISCOUS FLOW OF FLUX IN A PURE SUPERCONDUCTOR OF THE SECOND KIND. J. Volger, F. A.

Staas, and A. G. Van Vijfeijken (N. V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands). Phys. Letters, 9: 303-4(May 1, 1964).

A semiquantitative model of the resistive behavior of a pure superconductor of the second kind is presented for the case of viscous flow of flux. (R.E.U.)

24551 BOUND FERMION STATES ON A VORTEX LINE IN A TYPE II SUPERCONDUCTOR. C. Caroli, P. G. de Gennes, and J. Matricon (Faculte des Sciences, Orsay, France). Phys. Letters, 9: 307-9(May 1, 1964).

The excitations of low energy $\epsilon \ll \Delta_\infty$ (where Δ_∞ is the gap in zero field), which exist near an Abrikosov vortex line in a pure type-II superconductor, are discussed. Materials studied are restricted to those in which the Landau-Ginzburg parameter is much larger than unity and the field is much smaller than the upper critical field. (R.E.U.)

24552 A MODEL FOR THE MAGNETIC BEHAVIOUR AND THE I-H CURVE OF SUPERCONDUCTORS WITH AN ANCHORED FILAMENT STRUCTURE. L. N. J. de Jong and B. S. Blaisse (Laboratorium voor Technische Natuurkunde, Delft, Holland). Phys. Letters, 9: 309-11 (May 1, 1964).

A model is described for the calculation of the magnetization curve of a cylindrical superconducting rod in a field parallel to the rod axis, and the I-H curves for fields either parallel or perpendicular to the axis. Anchored superconducting filaments are assumed embedded either in a soft superconductor or in an insulator. (R.E.U.)

24553 BULK SUPERCONDUCTIVITY IN DILUTE HEXAGONAL TITANIUM ALLOYS. F. Heiniger and J. Muller (Federal Inst. of Tech., Zurich). Phys. Rev., 134: A1407-9(June 15, 1964).

The superconductivity, the low-temperature specific heat, and the paramagnetic susceptibility were investigated in a series of dilute hexagonal titanium alloys. In the solid solutions with V or Nb, both the transition temperature and the density of states are strongly increased and the entire volume exhibits superconductivity. A similar study of Ti-Fe alloys suggests either an incomplete volume transition or a different entropy variation in the superconducting state. (auth)

24554 POSSIBILITY OF SYNTHESIZING AN ORGANIC SUPERCONDUCTOR. W. A. Little (Stanford Univ., Calif.). Phys. Rev., 134: A1416-24(June 15, 1964).

London's idea that superconductivity might occur in organic macromolecules is examined in the light of the BCS theory of superconductivity. It is shown that the criterion for the occurrence of such a state can be met in certain organic polymers. A particular example is considered in detail. From a realistic estimation of the matrix elements and density of states in this polymer it is concluded that superconductivity should occur even at temperatures well above room temperature. The physical reason for this remarkable high transition temperature is discussed. It is shown further that the superconducting state of these polymers should be distinguished by certain unique chemical properties that could have considerable biological significance. (auth)

24555 ROLE OF s-d EXCHANGE INTERACTIONS IN DILUTE ALLOYS EXHIBITING BOTH LOW-TEMPERATURE RESISTANCE ANOMALIES AND SUPERCONDUCTIVITY. E. W. Collings, F. T. Hedgcock, and Y. Muto (Franklin Inst., Philadelphia). Phys. Rev., 134: A1521-6(June 15, 1964).

Measurements of the magnetic susceptibility of some dilute Zn–Mn alloys are reported in the temperature range where this alloy system is known to exhibit low-temperature resistance anomalies. All alloys studied obey a Curie law with the most concentrated alloy (0.43-at.% Mn) exhibiting deviations in the neighborhood of 6°K. The Curie constant indicates that manganese when dissolved in zinc has a spin value of $^2/_5$ which is temperature-independent between 5 and 273°K. Calculations of the exchange integral J from the magnetic properties of dilute Zn–Mn alloys were made from the Néel temperature, the magnetoresistivity as a function of field strength and the suppression of the superconducting critical temperature based on theoretical equations which assume a scalar s-d interaction between the paramagnetic ions and conduction electrons. All of the derived values of J lie in the range of $(1.4 \pm 0.2) \times 10^{-12}$ erg which would lead one to conclude that the magnetic interaction giving rise to these various effects is of the same nature. A graphical method for separating the resistance minimum from the total resistivity, in the presence of a resistance maximum produced by magnetic ordering in the Zn–Mn system, is presented. (auth)

24556 VORTEX WAVE SPECTRUM OF A TYPE II SUPERCONDUCTOR. H. J. Fink (Atomics International, Canoga Park, Calif.). Phys. Rev. Letters, 12: 578-80 (May 25, 1964).

It is shown that the vortex-wave spectrum of Abrikosov vortex lines has two frequency branches when the mass of the vortex line is included. For k(wave vector) = 0, the energy of the low-frequency branch is zero, and the high-frequency branch has a gap in the energy spectrum which gives rise to a resonance mode for a type II superconductor. The contribution of the vortex waves to the specific heat was also calculated. (L.B.S.)

24557 THE BOLTZMANN EQUATIONS IN ELECTRON-PHONON SYSTEMS. H. Froehlich and A. W. B. Taylor (Univ. of Liverpool). Proc. Phys. Soc. (London), 83: 739-48(May 1964).

Conditions on which the Boltzmann equations for electron–phonon systems (two coupled equations) can be derived without the use of the objectionable random phase approximation are considered. The treatment uses von Neumann's density matrix based on the hamiltonian introduced some time ago in connection with superconductivity. Formally exact expressions for the rate of change of coarse-grained one-particle distribution functions are derived. They become identical with the collision terms in the Boltzmann equations if (i) the influence of an external field on them is negligible, (iia) particle correlation is absent at an initial time, and (iib) the relevant series in terms of the interaction parameter converges and is at all times dominated by a certain term. The condition (iib) excludes the possibility of extensive correlations as they occur in superconductivity. (auth)

24558 ELECTRON DIFFRACTION PATTERNS FROM SOLID DEUTERIUM—A CORRECTION. A. E. Curzon and A. T. Pawlowicz (Imperial Coll. of Science and Tech., London). Proc. Phys. Soc. (London), 83: 888-9(May 1964).

The results of electron diffraction studies on deuterium suggest that solid deuterium has a face-centered cubic structure with four molecules per unit cell and a lattice parameter $a_0 = 5.07 \pm 0.02$ Å at about 7°K. (auth)

24559 SUPERCONDUCTOR RESONATORS IN THE METRIC WAVE. Jack Ruefenacht and Leo Rinderer (Université Lausanne, Switzerland). Z. Angew. Math. Phys., 15: 192-8(Mar. 25, 1964). (In French)

The resonance frequencies and quality factors of some superconductor resonators operating in the frequency range from 250 to 300 Mc/sec were measured. The results are presented, together with the characteristics of the resonators. Conclusions on the choice of materials, surface treatment, and operating conditions are included. (D.C.W.)

24560 EFFECT OF HIGH PRESSURE ON THE SUPERCONDUCTING PROPERTIES OF ZIRCONIUM. N. B. Brandt and N. I. Ginzburg (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 46: 1216-19(Apr. 1964). (In Russian)

The effect of pressure up to 24000 atm on the critical field and critical temperature T_c of the superconducting transition in zirconium is investigated in the temperature range from 0.08 to 0.8°K. It is found that T_c increases with pressure, the increase reaching 70% at 24000 atm. (auth)

24561 FERROMAGNETISM IN SUPERCONDUCTING ALLOYS. L. P. Gorkov and A. I. Rusinov (Inst. of Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 46: 1363-78(Apr. 1964). (In Russian)

The possibility of coexistence of ferromagnetism and superconductivity in alloys containing paramagnetic impurities is demonstrated. Due to exchange with the conductivity electrons, ordering of the spin impurities takes place. The impurity magnetization produces an electron spin space density $\langle\sigma\rangle$. Exchange interactions as $\langle\sigma\rangle$ compensates the loss in electron kinetic energy. The electron spin density is determined by the magnitude of the paramagnetic susceptibility. Even in superconductors the latter does not vanish at $T = 0$ due to electron scattering exchange effects on the paramagnetic impurities. If these effects are taken into account a comparatively narrow mixed state region separated from the purely superconducting phase by a line of transitions of the second kind and from the ferromagnetic phase by a line of a transition of the first kind. The narrowness of the coexistence region is related to the smallness of the exchange interaction. As a result exchange scattering effects play a smaller role than that of sliding Fermi surface which impedes the formation of singlet Cooper pairs. The introduction of spin-orbit scattering on nonmagnetic impurities whose concentration is usually larger, enlarges the coexistence region and makes it possible to explain the experimental results. Decrease of the effect of sliding of the Fermi surface can be explained by nonconservation of the electron spin in spin-orbit interactions. (auth)

24562 ON THE LOWER CRITICAL FIELD OF THIN LAYERS OF SUPERCONDUCTORS OF THE SECOND GROUP. A. A. Abrikosov (Inst. of Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 46: 1464-9(Apr. 1964). (In Russian)

Values of an external field are found for which quantized magnetic flux filaments first appear in thin layers of superconductors of the second group. It is shown that at this value the curve $M(H_0)$ exhibits a break and possesses a vertical tangent. (auth)

24563 SUPERCONDUCTIVITY IN A STRONG SPIN EXCHANGE FIELD. Peter Fulde and Richard A. Ferrell (Univ. of Maryland, College Park). 53p. (CONF-46-112)

From American Physical Society 1963 Spring Meeting, Washington, D. C., Apr. 1963.

A strong exchange field, such as produced by ferromagnetically aligned impurities in a metal, will tend to polarize the conduction-electron spins. If the metal is a superconductor, this will happen only if the spin-exchange field is sufficiently strong compared to the energy gap. When the field is strong enough to break many electron pairs, the self-consistent gap equation is modified and a new type of depaired superconducting ground state occurs. In the idealization of a spatially uniform exchange field with no scattering, it is found that the depaired state has a spatially dependent complex Gorkov field, corresponding to a non-zero pairing momentum in the BCS model. The presence of the "normal" electrons from the broken pairs reduces the total current to zero, gives the depaired state some spin polarization, and results in almost normal Sommerfeld specific heat and single-electron tunneling characteristics. The non-zero value of the pairing momentum also gives rise to an unusual anisotropic electrodynamic behavior of the superconductor, as well as to a degenerate ground state and low-lying collective excitations, in accordance with Goldstone's theorem. The effects of scattering in an actual superconducting ferromagnetic alloy were not studied and may interfere with experimental investigation of the theoretical results found for the idealized model. (auth)

Neutron Physics

24564 (BRL-1238) NEUTRON REFLECTION AND FLUX VERSUS DEPTH FOR ALUMINUM WITH AN APPENDIX: NEUTRON DOSE TRANSMISSION VERSUS THICKNESS. Frank J. Allen, Arnold T. Futterer, and William P. Wright (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Feb. 1964. 105p.

The results of calculations of neutron reflection and flux versus depth for aluminum are given in the form of machine printouts. The angular and energy distributions of the reflected neutrons, along with the energy-dependent and total flux at various depths, are presented in tabular form on the printouts. Neutron number current, number flux, and dose transmission as functions of thickness are similarly displayed. Information on reflection, including number current, number flux, dose, and energy reflection factors as functions of incident energy and angle is tabulated. The various tabular results are illustrated graphically. Dose transmission results as a function of incident angle and slab thickness for the various incident energies are given. The calculations were performed for eight incident energies between 0.1 and 14.0 Mev and for angles of 0, 30, 45, and 70°. (auth)

24565 (LA-3051) ANISOTROPIC SCATTERING APPROXIMATIONS IN THE BOLTZMANN TRANSPORT EQUATION. Kaye D. Lathrop (Los Alamos Scientific Lab., N. Mex.). Feb. 14, 1964. Contract W-7405-eng-36. 112p.

The effect of anisotropic scattering upon solutions of two elementary problems of monoenergetic neutron transport is examined. Solutions to the infinite homogeneous medium problem for a medium containing isotropic and anisotropic scatterers and a fission source, in which the diffusion length appears as an eigenvalue, are derived for several scattering approximations. Solutions are also derived for the spatially dependent neutron flux in the problem of a plane source in an infinite medium. In each problem, an exact solution for an anisotropic scatterer with purely forward and backward scattering is examined. The relative effectiveness of the scattering approximations developed is evaluated numerically, and extensive tables of solutions for elastic hydrogen scattering are tabulated for reference. (auth)

24566 (NP-13912) ISSLEDOVANIE TERMALIZUYUSHCHIKH SVOISTV VODY I NEKOTORYKH ORGANICHESKIKH SOEDINENII S POMOSHCHYU IZMERENIYA SECHENII NEUPRUGOGO RASSEYANIYA MEDLENNYKH MONOKROMATICHESKIKH NEITRONOV. (Investigation of the Thermalizing Properties of Water and of Certain Organic Compounds by Means of Measuring the Inelastic Scattering Cross Section of Slow Monochromatic Neutrons). V. I. Mostovoi, I. P. Sadikov, A. A. Chernyshov, and I. P. Eremeev (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). 1963. 51p.

Data are presented on differential cross sections for inelastic scattering of slow monochromatic neutrons $\sigma(E, E', \theta)$ in water and in monoisopropyldiphenyl ($C_{15}H_{16}$). A mechanical monochromator was used for separating the thermal neutron beam. The resolving power of the monochromator is not a function of the rate of rotation and is equal to $\Delta E/E = 0.2$. The energy E′ of neutrons scattered at an angle θ was measured by time-of-flight with a resolving power ~25 μsec/m. The cross sections for inelastic scattering were measured for neutron energies of 16, 26.6, 50.7, 102.3, 137, 200, and 326 Mev at 15, 30, 60, 90 and 120° scattering angles. The obtained cross sections were used in calculations of mean scattering characteristics; $E'(E)$, (E), $\cos(\theta)$, M_2, and others. Correlations of cross sections and mean characteristics of neutron scattering in water and monoisopropyldiphenyl indicate a stronger chemical hydrogen bond in monoisopropyldiphenyl. Neutron thermalization in monoisopropyldiphenyl is slower than in water. Scattering regularities for $S(d,\beta)$ were found and a generalized frequency spectrum $P(\beta)$ for H_2O at T = 23°C was constructed. The obtained data may be used for measuring neutron spectra in systems with water or organic moderator. (tr-auth)

24567 (NP-13930) DISKUSSIONSTAGUNG UBER NEUTRONENPHYSIK, 8 BIS 10 OKTOBER 1963, KERNFORSCHUNGSZENTRUM, KARLSRUHE. (Discussion Meeting on Neutron Physics, Karlsruhe, Germany, October 8-10, 1963). (Deutsches Atomforum e. V., Düsseldorf; Verband Deutscher Physikalischer Gesellschaften e. V., Brunswick; and Kernreaktor Bau- und Betriebs-Gesellschaft m.b.H., Karlsruhe, Germany). 181p.

In German, English, and French.

Thirty-eight papers and 13 summaries of papers presented at the Discussion Meeting on Neutron Physics are given. Separate abstracts were prepared for each of the 38 papers. (M.C.G.)

For abstracts of individual papers see: 23838, 23878, 23879, 23880, 23881, 23882, 23883, 23884, 23885, 24194, 24246, 24247, 24299, 24568, 24569, 24570, 24594, 24595, 24596, 24597, 24598, 24599, 24600, 24601, 24602, 24603, 24604, 24605, 24606, 24607, 24608, 24609, 24610, 24611, 24612, 24613, 24849, and 24961.

24568 (NP-13930(p.78-9)) DURCHGANG POLARISIERTER NEUTRONEN DURCH MAGNETISIERTES EISEN. (Passage of Polarized Neutrons Through Magnetized Iron). G. Weber (Kiel. Universität).

Two oppositely polarized neutron beams were directed onto a soft iron sample. Count rates for each beam in magnetized sample were calculated. The depolarization coefficient for the beams showed a linear dependence on the reciprocal field strength of the sample. (M.C.G.)

24569 (NP-13930(p.119-20)) KALTE NEUTRONEN DURCH TOTALREFLEKTION. (Cold Neutrons by Total Reflection). H. Kuersten (Kiel. Universität).

Measurements were made, which should clarify how the total reflection of neutrons on reflectors can be used for production of a cold spectrum. Equations for angular distribution and transmission are given. (M.C.G.)

24570 (NP-13930(p.141-3)) DIE NEUTRONENBLITZROHRE—EINE STARKE, GEPULSTE NEUTRONENQUELLE. (The Neutron Flash Tube—A Strong, Pulsed Neutron Source). A. Schmidt (Kernforschungzentrum, Karlsruhe, Germany).

A strong pulsed neutron source with pulse durations of about 10^{-5} to 10^{-7} sec and more than 10^9 neutrons/pulse (corresponding to about 10^{15} neutrons/sec) was developed. Deuterium reactions on tritium–titanium targets with deuteron energies of 200 kev maximum were used. The D^+ ions were obtained by high-frequency discharges in deuterium. (M.C.G.)

24571 (RPI-328-6) PROGRESS REPORT [ON LINEAR ACCELERATOR PROJECT], JANUARY THRU MARCH 1964. E. R. Gaerttner (Rensselaer Polytechnic Inst., Troy, N. Y.). Contract AT(30-3)-328. 51p.

Information is summarized on: time-dependent neutron spectra in Be and D_2O; neutron resonance capture by W isotopes (mass numbers 182, 183, 184, and 186) at 110 to 500 ev; neutron resonance capture Hf isotopes (mass numbers 176, 177, 178, 179, and 180) at 30 to 1200 ev; neutron extrapolation lengths in polythene at 0.004 to 0.4 ev; and distributions from neutron inelastic scattering by polythene at 0.1 to 1 ev. (T.F.H.)

24572 (WAPD-TM-416) WIGLE—A PROGRAM FOR THE SOLUTION OF THE TWO-GROUP SPACE-TIME DIFFUSION EQUATIONS IN SLAB GEOMETRY. W. R. Cadwell, A. F. Henry, and A. J. Vigilotti (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Jan. 1964. Contract AT-11-1-GEN-14. 28p.

The one-dimensional, two-group diffusion theory program WIGLE calculates the space-time behavior of a reactor during a transient associated with a time-dependent change of reactor parameters. Input preparation and output are described; and the equations solved by the program are given, together with an input listing and output for a sample problem. (D.C.W.)

24573 VARIATIONAL BOUNDARY CONDITIONS FOR THE SPHERICAL HARMONICS APPROXIMATION TO THE NEUTRON TRANSPORT EQUATION. G. C. Pomraning (General Electric Co., Pleasanton, Calif.). Ann. Phys. (N. Y.), 27: 193-215(Apr. 1964).

It is shown that the monoenergetic neutron transport equation and the associated boundary conditions can be characterized by a Lagrangian. A proper choice of the trial function for this Lagrangian leads to the widely used spherical harmonics approximation as the Euler-Lagrange equations. A set of boundary conditions for the spherical harmonic equations is the result of the logical application of the variational method. These variational boundary conditions appear to be significantly more accurate than the boundary conditions presently in general use. For example, the use of the variational boundary conditions at a free surface reduces the error (compared with the boundary conditions presently used) in the linear extrapolation distance for the Milne problem by several factors. In particular, the P-1 (diffusion) approximation yields a value of 0.7071 (in units of mean free paths) and the P-3 approximation yields a value of 0.7118, both comparing quite favorably with the exact value of 0.7104. (auth)

24574 DELAYED NEUTRON YIELD FROM URANIUM TARGET BOMBARDED BY ELECTRONS. Kyue Fukuda, Shigeru Okabe, Shigeki Nakamura, and Toshio Azuma. Ann. Rept. Radiation Center Osaka Prefect., 4: 55-7(1963).

The yield of delayed neutrons from a uranium target bombarded by electrons was investigated as a function of electron energy for the range of 8 to 13 Mev using a 15-Mev electron Linac. The yield per fission in photo-fission was also studied. The results showed that the delayed neutrons per prompt one were slightly smaller at the electron energy of 10.9 Mev than other values obtained at different energies. The calculated values for delayed neutrons per photo-fission were found constant for the energy range 8 to 13 Mev. Data are tabulated. (P.C.H.)

24575 EXCITATION SPECTRA OF NEUTRON IRRADIATED ZnS; Cu PHOSPHORS. Takeyoshi Seiyama, Toshio Yoshida, and Hitoshi Nishimura. Ann. Rept. Radiation Center Osaka Prefect., 4: 67-70(1963).

The results of experiments on excitation spectra of several kinds of ZnS phosphors irradiated with fast neutrons are reported. The total fast neutron flux was 6.5 × 10^{16} nvt accompanied by the same number of thermal neutrons. At room temperature, the spectra suffered little change from neutron irradiation of 1.5 × 10^{16} nvt. In every spectrum, two peaks are seen at the wavelengths of about 3350 and 3650 Å, which are attributed to luminescence emission due to fundamental and characteristic absorptions of exciting light, respectively. A sample containing 0.001% Cu activator showed clearly a greater decrease of the peak due to characteristic absorption than that of the peak due to fundamental absorption. This was not appreciable for samples containing 0.01% Cu activator. Decreases of blue and green luminescence intensities are attributed to self-absorption of luminescence of the sample itself irradiated with neutrons, and the greater decrease of luminescence intensity due to characteristic absorption than that to fundamental absorption is also attributed to the increase of self-absorption intensity caused by irradiation. (P.C.H.)

24576 NEUTRON SLOWING-DOWN SPECTRA IN BERYLLIUM AND BERYLLIUM OXIDE. T. H. Axford (Univ. of Melbourne), K. C. Hines, and J. P. Pollard. J. Nucl. Energy, Pt. A & B, 18: 131-9(Mar. 1964).

The collision density of neutrons slowing down in an infinite homogeneous moderator was obtained as a function of neutron energy for beryllium and beryllium oxide. The source fission neutrons were uniformly distributed in space. The spectra were obtained by solving the slowing-down integral equation numerically using a digital computer. The reactions considered were anisotropic elastic scattering in Be and O, (n,α) in Be and O, and (n,2n) in Be. Both the direct interaction and compound nucleus mechanisms were used for the (n,2n) reaction. (auth)

24577 EFFECT OF LATTICE STRUCTURE ON NEUTRON DIFFUSION. L. S. Kothari (Univ. of Delhi). J. Sci. Ind. Res., 23: 45-8(Feb. 1964).

Some cases in which the influence of lattice structure on the diffusion of neutrons in a solid is particularly marked are considered. In particular, the variation of the transport mean free path with temperature, diffusion cooling constant and equilibrium energy distribution are examined in some detail in the case of Be and BeO. The diffusion cooling constant is found to depend sensitively on the transport mean free path and the equilibrium energy distribution. (auth)

24578 IONOGRAPHIC STUDY OF 15.9-Mev NEUTRONS IN PARAFFIN AND OF THE THERMAL FISSION CROSS SECTION OF ^{235}U. Claude Allain (Univ. of Montreal). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 668-74(1963). (In French)

Nuclear emulsions are used to determine the density distributions of neutrons slowed down in paraffin, and to measure the ratio of the cross sections of ^{235}U and natural B for these neutrons. (T.F.H.)

24579 TARGET RELOADING IN NEUTRON GENERATORS. H. Hollister (Kaman Nuclear, Colorado Springs, Colo.). Nucleonics, 22: No. 6, 68-9(June 1964).

The normal mode of operation of a d-t neutron generator consists in the reaction $T(d,n)^4He$ at a deuteron energy of about 200 kev. The target consists of tritiated Ti. After a few hours of operation, most of the T in the target has been replaced by D, so that the neutron output falls off drastically. A "reloading" method is described, consisting in bombarding the deuterated target with tritons via the reaction $D(t,n)^4He$. The convenience and economy of target reloading is compared with that of target replacement. (T.F.H.)

24580 SCATTERING OF THERMAL NEUTRONS BY POLARIZED NUCLEI OF THE ATOMS OF A FERROMAGNETIC. G. A. Kharadze (Inst. of Physics, Academy of Sciences, Georgian SSR). Zh. Eksperim. i Teor. Fiz., 46: 1461-3(Apr. 1964). (In Russian)

Interference phenomena occurring during scattering of thermal neutrons on polarized nuclei of the atoms of a ferromagnetic lattice are considered. It is noted that due to interference between magnetic and incoherent nuclear scattering the sign of the incoherent amplitude may be determined. For this purpose it should be sufficient to employ a polarized thermal neutron beam. (auth)

24581 AN INTRODUCTION TO NEUTRON TRANSPORT THEORY. J. H. Tait. Mathematical Physics Series. London, Longmans, Green and Co. Ltd., 1964. 151p. 24s.

The mathematical methods used in neutron transport theory are surveyed. The physical processes in neutron-nucleus collisions are briefly discussed, and the neutron transport equations are derived. The one-velocity-group equation and its solution, particularly by expansion methods, is then considered. The diffusion approximation is presented; and the solution of the energy dependent equation is considered, starting with the calculation of the neutron spectrum during slowing down in an infinite medium. The Milne problem, the age equation, and the neutron distribution at large distances from the source are developed; and numerical methods and perturbation theory are described. (D.C.W.)

Nuclear Properties and Reactions

Refer also to abstract 24571.

24582 (AD-439331) ABSORPTION OF NEGATIVE PI MESONS IN LIGHT NUCLEI. Technical Report No. 46. G. T. Condo and R. D. Hill (Illinois. Univ., Urbana). Mar. 1964. Contract NONR-1834(05). 10p.

Meson (π^-) stars observed in normal Ilford G-5 emulsion and in water-soaked G-5 emulsion were examined. It was found that 57.5% of all meson (π^-) stars in the normal emulsion were caused by absorption in heavy nuclei, while such absorption accounted for only 43% of all meson (π^-) stars in the water-soaked emulsion. Events in the light nuclei were separated into captures in C, N, and O on the basis of the number of prongs and the distinction between proton and alpha prongs. Specific results are given, together with the results of other determinations for normal emulsions. (D.C.W.)

24583 (CONF-502-4)) THE RELATIVE SIZE OF Ca^{44} AND Ca^{40}. N. S. Wall, G. Heyman, R. W. Bauer, and A. M. Bernstein (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). [1964]. Contract AT(30-1)-2098. 5p.

For Presentation at International Congress of Nuclear Physics, Paris, July 1964.

The differential cross sections for the elastic scattering of 30.5 Mev alpha particles were measured for ${}^{40}Ca$ and ${}^{44}Ca$ from 20° to 70°. From a diffraction analysis it is concluded that the interaction radius of ${}^{44}Ca$ is larger than that of ${}^{40}Ca$ by an amount consistent with an $A^{1/3}$ law. This result is contrasted with a recent measurement of the μ mesic x rays of ${}^{40}Ca$ and ${}^{44}Ca$ which suggested that the charge radius of ${}^{40}Ca$ is larger than that of ${}^{44}Ca$. (auth)

24584 (IDO-16956) THE TOTAL NEUTRON CROSS SECTION OF 115-DAY Ta-182 BELOW 3.0 ev. G. E. Stokes, J. R. Berreth, R. P. Schuman, O. D. Simpson, and T. E. Young (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 1, 1964. Contract AT(10-1)-205. 38p.

The total cross section for Ta^{182} was measured from 0.01 to 3.0 ev using the Materials Testing Reactor fast chopper. Curves and tables of the total cross section as a function of energy are given. The resonance parameters for the 0.147 and 1.82 ev resonances are presented. The thermal cross section is 8,200 ± 500 b, and the 0.147-ev resonance peaks at 46,000 ± 3,000 b. (auth)

24585 (IDO-16969) GAMMA-RAY SPECTROMETRY OF NEUTRON-DEFICIENT ISOTOPES. Annual Progress Report. R. L. Heath and J. E. Cline (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Mar. 27, 1964. Contract AT(10-1)-205. 48p.

The objective is to produce a set of pulse-height spectra representing the response of a standard gamma scintillation spectrometer to radiations emitted in the decay of neutron-deficient nuclides. The purpose of this collection of data is to provide reference material for experimenters applying the techniques of scintillation spectrometry to the measurement of accelerator-produced isotopes. Work included the production of a large number of radioactive nuclides by gamma-ray- and proton-induced reactions. The methods employed for source production, the experimental equipment, and measurement techniques are described. Spectra of over 20 neutron-deficient isotopes are presented in final form. (auth)

24586 (IDO-16976) EXPERIMENTAL MEASUREMENT OF THE FISSION CROSS SECTION OF Pu^{241}. T. Watanabe, M. S. Moore, O. D. Simpson (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho); J. E. Russell, and R. W. Hockenbury (Rensselaer Polytechnic Inst., Troy, N. Y.). Apr. 10, 1964. Contract AT (10-1)-205. 31p.

The low-energy neutron-induced fission cross section of ${}^{241}Pu$ was measured from 2-100 ev, with sufficiently high resolution to permit multilevel analysis below neutron energies of 36 ev. Curves and tables of the fission cross section as a function of neutron energy are given. (auth)

24587 (JINR-P-1584) RASCHET ROZHDENIYA CHASTITS NA YADRAKH. (Production of Particles in Nuclei). V. A. Belyakov, A. V. Boyadzhiev, N. V. Viryasov, and V. M. Mal'tsev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy and Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 18p.

The Monte-Carlo method was used for calculating cascades induced by 7-Bev/c π mesons on ${}^{9}Be$, ${}^{12}C$, ${}^{16}O$, ${}^{19}F$, ${}^{27}Al$, ${}^{35}Cl$, ${}^{64}Cu$, ${}^{80}Br$, ${}^{131}Xe$, and ${}^{207}Pb$. Calculations were made of nucleon, π and K meson, and λ and Σ hyperon production cross sections, and the angular and momentum characteristics of produced particles were determined. Transmission coefficients were found for the nuclei, and particle production cross sections were analyzed as a function nuclear mass and incident particle momentum. (R.V.J.)

24588 (JINR-P-1595) O SVYAZI OBOLOCHECHNYKH I KLASTERNYKH VOZBUZHDENII V LEGKIKH YADRAKH. (On the Coupling Between Shell Model Excitations and Cluster Excitations in Light Nuclei). V. V. Balashov and I. Rotter (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 10p.

The reduced α-widths for some levels of ${}^{12}C$ and ${}^{8}Be$ are calculated in the framework of the shell model with intermediate coupling. A classification of α-transitions with regard to the permutation symmetry of the wave function is given. A comparison of calculated and experimental α-widths shows that for ${}^{12}C$ the shell model gives values in the right order of magnitude only for those levels where no mixing with cluster levels takes place (levels 1+). For all the other levels the calculated Θ_α^2-values are less than the experimental ones. The mixing of shell model levels with levels of a collective nature is discussed. (auth)

24589 (KAPL-M-6131) FORDRAM—A PROGRAM TO CALCULATE GROUP AVERAGE MICROSCOPIC RESONANCE ABSORPTION AND FISSION CROSS SECTIONS FOR USE IN DRAM. M. G. Fuda and J. E. Tuecke (Knolls Atomic Power Lab., Schenectady, N. Y.). Mar. 1964. Contract W-31-109-eng-52. 29p.

The program FORDRAM calculates epithermal resonance absorption cross sections for U^{235}, U^{238}, Zr, and Al, as well as the resonance fission cross sections for U^{235}. The cross sections are calculated to take into account energy self-shielding using L-factors, spatial self-shielding, and Doppler broadening. The calculated cross sections are also punched on cards. Input is discussed, and cross section relations and sample input are included. (D.C.W.)

24590 (LADC-6370) (He^3,d) REACTION ON $Ni^{58,60}$. A. G. Blair (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract W-7405-eng-36. 6p. (CONF-502-6)

For Presentation at International Congress of Nuclear Physics, Paris, July 1964.

The (${}^{3}He$,d) reaction on ${}^{58,60}Ni$ was observed at an incident beam energy of 22 Mev. Partial angular distributions of deuterons corresponding to ${}^{59,61}Cu$ states between 0 and 4 Mev of excitation were obtained. From comparison of the angular distributions to the predictions of a distorted-wave calculation, the orbital angular-momentum transfers and spectroscopic factors of the states were obtained. The results resemble previously published results from the ${}^{62}Ni({}^{3}He,d){}^{63}Cu$ reactions, i.e., they are consistent only with the interpretation that large fractions (in the present case, 50 per cent or more) of the $T = T_z$ components of the $p_{1/2}$ and $f_{5/2}$ proton single-particle strengths lie in the first and second excited states, respectively. (auth)

24591 (LMSC-4-50-62-1) AEC NUCLEAR RESEARCH PROGRAM AT LMSC. Interim Report. (Lockheed Missiles & Space Co., Sunnyvale, Calif.). Oct. 1962. Contract AT(04-3)-435. 34p.

Cross sections for ^{197}Au(n,γ) and ^{64}Ni(n,γ) reactions and neutron total cross sections for Na, K, and Ca are given. The ^{198}Au gamma spectra and neutron yields for the ^{51}V(p,n) reaction are illustrated. (C.E.S.)

24592 (NP-13913) EKSPERIMENTAL'NOE OPREDELENIE VYKHDA NATRIYA-24 IZ ALYUMINIYA V VODU PRI OBLUCHENII ALYUMINIEVYKH OBRAZTSOV V REAKTORE IRT. (Experimental Determination of the Yield of Sodium-24 From Aluminum in Water During Irradiation of Aluminum Samples in a Thermal Research Reactor (IRT)). V. T. Korneev, V. I. Mitin, and Yu. F. Chernilin (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). 1963. 13p.

A method is suggested for determining the ^{24}Na yield in ^{27}Al(n,α)^{24}Na reactions in water in the IRT reactor. It was found that the yield of ^{24}Na was ~9.5×10^{-10} (atoms/cm^2 sec)(H/cm^2 sec). (tr-auth)

24593 (NP-13925) THEORY OF NUCLEAR MATTER. Lecture given by G. E. Brown at Universitetets Institut for Teoretisk Fysik and NORDITA Copenhagen. (Nordisk Institut for Teoretisk Atomfysik, Copenhagen). 1964. 130p.

The Hartree calculations (self-consistent fields) are first reviewed, and the Hartree-Fock equations are derived using the occupation number representation. Perturbation theory (use of the Hartree-Fock wave functions and energies) is then reviewed, and the concept of nuclear matter is introduced. The binding energy calculation for nuclear matter with a well-behaved N-N force is considered, and Brueckner's theory that accounts for the strong short-range repulsions currently used in the N-N force is then reviewed. Numerical results are briefly discussed. (D.C.W.)

24594 (NP-13930(p.1-5)) NEUTRONENREAKTIONEN AND OPTISCHES KERNMODELL. (Nuclear Reactions and Optical Nuclear Model). G. Suessmann (Frankfurt am Main. Universität).

The effectiveness of the optical model in neutron reaction studies was considered. Spin-orbit coupling, nuclear deformation and charge dependence, non-local potential, and direct nuclear reactions are discussed. (M.C.G.)

24595 (NP-13930(p.6-13)) TRANSMISSIONSKOEFFIZIENTEN (T_l-WERTE) UND ABSORPTIONSQUERSCHNITTE FUR NEUTRONEN, PROTONEN UND ANDERE TEILCHEN NACH DEM OPTISCHEN MODELL. (Transmission Coefficients (T_l-Values) and Absorption Cross Sections for Neutrons, Protons, and Other Particles According to the Optical Model). H. Meldner (Frankfurt am Main. Universität).

Using an optical nuclear model, transmission coefficients (absorption probabilities) for individual partial waves as well as absorption interaction cross sections were calculated. These values, which are necessary for calculations of neutron reactions and Ericson fluctuations, were determined for protons and neutrons for several nuclei and energies from 1 to 25 Mev. Results are shown in graphs. (M.C.G.)

24596 (NP-13930(p.14)) NEUERE ARBEITEN ZU DEN TERMDICHTEN. (New Work on Level Densities). H. Buettner (Frankfurt am Main. Universität).

Work on nuclear level density formulas is reviewed. Calculations for gamma emission following (n,2n) processes are shown. (M.C.G.)

24597 (NP-13930(p.15)) EINE ANWENDUNG DES OPTISCHEN MODELLS UND DES KOLLEKTIVMODELLS ZUR BESTIMMUNG UNELASTISCHER STREQUERSCHNITTE AN Na^{23} BIS 4 Mev. (A Use of the Optical Model and the Collective Model for Determination of Inelastic Scattering Cross Sections on ^{23}Na to 4 Mev). G. Bundschuh, D. Emendoerfer, W. Gloeckle, and H. J. Siegert (Stuttgart. Technische Hochschule).

The Hauser-Teshbach theory was used in calculations of neutron inelastic scattering on ^{23}Na at energies to 4 Mev. The penetration factor was calculated according to the optical model by the Bjorklund-Fernbach potential with spin-orbit coupling toward the end of the resonance region at 4 Mev the theoretical results corresponded well with the experimental curve. (M.C.G.)

24598 (NP-13930(p.17-25)) STATISTIK DER KERNNIVEAUABSTANDE UND BREITEN. (Statistics of Nuclear Level Intervals and Widths). Helmut Jahn (Kernforschungszentrum, Karlsruhe, Germany).

The statistical properties of the intervals of neutron resonance levels and the statistics of their widths are discussed. Empirical examples and level repulsion effects are described. Statistics of the many-particle Hamiltonian matrix were determined. The matrix elements, the statistical assumptions, the total distribution function for matrix elements, the total eigenvalue distribution, the Coulomb model of level repulsion, calculation of internal distribution, and width distribution are discussed. (M.C.G.)

24599 (NP-13930(p.26-38)) NEUTRONENINDUZIERTE REAKTIONEN IN SILIZIUM-HALBLEITERZÄHLERN. (Neutron-Induced Reactions in Silicon Semiconductor Counters). G. Andersson-Lindstroem (Germany. Physikalisches Staatsinstitut, Hamburg).

Reactions of neutrons in silicon semiconductor detectors are reviewed. The following reactions are possible: ^{28}Si(n,α)^{25}Mg, ^{28}Si(n,p)^{28}Al, ^{29}Si(n,α)^{26}Mg, and ^{28}Si(n,d)^{27}Al. The principle for registering the particles from these reactions in the semiconductor detector are demonstrated. Examples are given for spectra and cross section measurements for neutron reactions at different energy levels. (M.C.G.)

24600 (NP-13930(p.39-40)) UNTERSUCHUNGEN VON NEUTRONEN-WIRKUNGSQUERSCHNITTEN AN SILIZIUM IM ENERGIEBEREICH 5–9 Mev MIT HALBLEITERZÄHLERN. (Investigations of Neutron Interaction Cross Sections on Silicon in the Energy Region 5 to 9 Mev with Semiconductor Detectors). G. Betz, W. Mausberg, and E. Roessle (Frankfurt am Main. Universität).

Differential cross sections under 90 ± 30° for the reaction ^{28}Si(n,p)^{28}Al are reported. The excitation functions of the ^{28}Si(n,α)^{25}Mg, ^{28}Si(n,p)^{28}Al, and ^{29}Si(n,α)^{26}Mg reactions showed strong variations from in an average course, which were energy dependent. The experiments were not incompatible with the theory of Ericson. (M.C.G.)

24601 (NP-13930(p.41-2)) EINIGE BETRACHTUNGEN ÜBER DIE SYSTEMATIK DER WIRKUNGSQUERSCHNITTE VON DURCH MITTELSCHNELLE NEUTRONEN AUSGELÖSTEN KERNREAKTIONEN. (Some Observations on the Systematics of Effective Cross Sections of Nuclear Reactions Caused by Medium-Fast Neutrons). M. Bormann (Germany. Physikalisches Staatsinstitut, Hamburg).

Nuclear reactions caused by neutrons at 14 Mev were studied to determine cross sections. A systematic compilation of cross-section measurements was undertaken. The size of the cross sections for various reaction types showed a dependence on the evenness and oddness of the number of protons and neutrons in the rest nucleus. A shell effect in the nuclear level density was observed. (M.C.G.)

24602 (NP-13930(p.43-9)) UNTERSUCHUNGEN ÜBER DIE ENERGIEABHANGIGKEIT EINIGER NEUTRONEN-WIRKUNGSQUERSCHNITTE. (Investigations on the Energy Dependence of Some Neutron Reactor Cross Sections). M. Bormann and E. Fretwurst (Germany. Physikalisches Staatsinstitut, Hamburg).

The course of cross sections of some neutron-induced nuclear reactions in the energy region from 12.5 to 19.6 Mev was investigated with the help of activation methods. The excitation functions and cross sections for the following reactions were measured: $^{19}F(n,p)^{19}O$, $^{55}Mn(n,\alpha)^{52}V$, $^{14}N(n,2n)^{13}N$, $^{39}K(n,2n)^{38}K$, and $^{88}Sr(n,2n)^{87m}Sr$. (M.C.G.)

24603 (NP-13930(p.51-3)) UN SPECTROMÉTRE DE NEUTRONS RAPIDES PAR TEMPS DE VOL. APPLICATION À L'ÉTUDE DE LA DISTRIBUTION ANGULAIRE DE LA DIFFUSION INÉLASTIQUE DE NEUTRONS DE 14 Mev SUR LE CARBONE. (On the Spectrometry of Fast Neutrons for Time-of-Flight Applications to Studies of the Angular Distribution of the Inelastic Diffusion of Neutrons at 14 Mev in Carbon). G. A. Grin, C. Joseph, J. C. Alder, B. Vaucher, and J. F. Loude (Lausanne, Switzerland. Université. Ecole Polytechnique. Laboratoire de Recherches Nucléaires).

The angular distributions from neutron reactions (n,2n) and (n,n′γ) with carbon at 14 Mev were studied by time-of-flight spectrometry. (M.C.G.)

24604 (NP-13930(p.54-5)) ERLANGER UNTERSUCHUNGEN MIT 14 Mev-NEUTRONEN AUS $H^3(d,n)He^4$. (Production Investigations for 14-Mev Neutrons from $^3H(d,n)^4He$). A. Hofmann (Erlangen, Germany. Universitat).

A sum-coincidence spectrometer, was built and its characteristics determined. Calcium, oxygen, and carbon were bombarded with 14-Mev neutrons, and the gamma spectra originating were measured. A value of 150 mb ±30% was obtained for the cross section of the reaction $^{27}Al(n,\alpha)^{24}Na$ at 14 Mev. (M.C.G.)

24605 (NP-13930(p.59-71)) INELASTISCHE STREUUNG VON NEUTRONEN AN VANADIUMHYDRID. (Inelastic Scattering of Neutrons on Vanadium Hydride). R. Rubin, W. Kley, and Petetti (European Atomic Energy Community. European Scientific Data Processing Center, Ispra, Italy).

Spectra from inelastic scattering of neutrons by vanadium and vanadium hydride with 4, 9, and 20% hydrogen and at temperatures between 30 and 150°C are shown. (M.C.G.)

24606 (NP-13930(p.73-4)) DIE BEDEUTUNG VON GESAMTEN UND EINFACHEN DIFFERENTIELLEN WIRKUNGSQUERSCHNITTEN FUR LANGSAME NEUTRONEN. (The Significance of Total and Simple Differential Interaction Cross Sections for Slow Neutrons). T. Springer (Kernforschungsanlage, Julich, Germany).

Measurements of total and differential cross sections for neutron reactions are discussed. (M.C.G.)

24607 (NP-13930(p.104-8)) KERNPHYSIKALISCHE UNTERSUCHUNGEN MITTELS DER (n,γ)-REAKTION. (Nuclear Physics Investigations by Means of the (n,γ) Reaction). N. Fiebiger (Frankfurt am Main. Universität).

Experimental methods for nuclear physics using the (n,γ) reaction are reviewed. The (n,γ) reaction is compared with the (d,p) reaction. The capture mechanism and decay of the compound nucleus and (n,γ) reactions to determine nuclear structure are discussed. (M.C.G.)

24608 (NP-13930(p.110-11)) MESSUNG VON (n,γ)-WIRKUNGSQUERSCHNITTEN UND RESONANZINTEGRALEN MIT EINEM BLEISPEKTROMETER. (Measurement of (n,γ) Interaction Cross Sections and Resonance Integrals with a Lead Spectrometer). F. Mitzel and H. S. Plendl (Kernforschungszentrum, Karlsruhe, Germany).

A lead spectrometer was used to determine the (n,γ) cross sections of Ag, Mo, and Fe. A lead cube of 1.6 m edge length was used as moderator to produce a periodic pulse of fast neutrons. The substance to be studied was placed inside the lead block and the prompt gamma radiation from neutron capture was measured as a function of time. The energy resolution possibility amounted to about 20% between 1 ev and 35 kev. (M.C.G.)

24609 (NP-13930(p.112-13)) CHOPPER-WIRKUNGSQUERSCHNITTMESSUNGEN AN PALLADIUM BEI EPITHERMISCHEN NEUTRONENENERGIEN. (Chopper Reaction Cross Section Measurements on Palladium for Epithermal Neutron Energies). W. Biel, W. Komenda, and H. Nohadani (Kiel. Universitat).

Neutron transmission and reaction cross sections of 10-mm palladium sample were measured in the energy region from 1.2 to 10 ev. Results are shown on graphs. (M.C.G.)

24610 (NP-13930(p.114-15)) EINE MESSUNG DES ISOMEREN AUFSPALTVERHÄLTNISSES BEI DEN ERSTEN 3 INDIUM RESONANZEN. (A Measurement of the Isomeric Splitting Ratio of the First 3 Indium Resonances). E. Albold and P. von Blankenhagen (Kernforschungszentrum, Karlsruhe, Germany).

After neutron irradiation of ^{115}In, beta decays from two isomers of ^{116}In were observed. Isomeric ratios for the first, second, and third resonances were measured and calculated. (M.C.G.)

24611 (NP-13930(p.132-3)) UNTERSUCHUNG DER (d,n)-REAKTION AN DEN KERNEN Be^9, B^{10}, B^{11}, Si^{28}, P^{31}. (Investigations of the (d,n) Reaction on the Nuclei ^9Be, ^{10}B, ^{11}B, ^{28}Si, ^{31}P). R. H. Siemssen, M. Cosack, and R. Felst (Germany. Physikalisches Staatsinstitut, Hamburg).

Deuteron reactions (d,n) with ^9Be, ^{10}B, ^{11}B, ^{28}Si, and ^{31}P were determined. (M.C.G.)

24612 (NP-13930(p.134)) DIE REAKTION $Ti^{46}(p,n)V^{46}$. (The Reaction $^{46}Ti(p,n)^{46}V$). J. Jaenecke (Florida State Univ., Tallahassee and Kernforschungszentrum, Karlsruhe, Germany).

The excitation function for the formation of short-lived ^{46}V activity in proton reactions (p,n) on ^{46}Ti in the region from 7.2 to 9.5 Mev was measured. Excited states in ^{46}V were observed at 0.55 ± 0.02, 0.81 ± 0.03, and 1.16 ± 0.03 Mev. (M.C.G.)

24613 (NP-13930(p.139)) RARE NUCLEAR REACTIONS INDUCED BY 14.7 Mev NEUTRONS. R. W. Fink (Marquette Univ., Milwaukee).

Neutron reactions (n,nα), (n,2p), $(n,^3He)$, (n,γ), (n,3n), and (n,pn) with various nuclei were studied at 14.7 ± 0.2 Mev to determine activation cross sections. (M.C.G.)

24614 (NP-13941) NUCLEAR DEFORMATIONS IN THE PAIRING-PLUS-QUADRUPOLE MODEL I. THE SINGLE-j SHELL. Technical Report No. 15. Michel Baranger and Krishna Kumar (Carnegie Inst. of Tech., Pittsburgh). Mar. 1964. Contract 760(15) NR024-439. 43p.

The motivation and basic assumptions of the pairing-plus-quadrupole model are reviewed. Analytical and numerical applications are made to the single-j shell, demonstrating the competition between the deforming effect of the quadrupole force and the spherifying effect of the pairing force. When it is deformed, the single-j shell is always axially symmetric. Cases are found for which the potential energy of deformation has a spherical minimum and a deformed minimum simultaneously. The results are valid for any j. The importance of zero-point motion is studied and is found to decrease with increasing j. (auth)

24615 (NP-13959) O NOVOM PODKHODE K TEORII YADRA. (New Approach to the Theory of Nuclei). A. B. Migdal (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 32p.

Aspects of Green's functions in nuclear theory are considered in shell model problems, nuclei in external fields, effective field equations for pair correlations, interactions between quasiparticles, interaction amplitudes, quadrupole-quadrupole nuclear interactions, and in matrix density variations with an additional particle and in strong fields. Magnetic moments, moments of inertia, transition probabilities and dipole effects are also considered. (R.V.J.)

24616 (NP-13964) POISKI LEGKIKH NEITRONNYKH YADER. (Search for Light Neutron Nuclei). O. D. Brill, N. I. Venikov, A. A. Kurashov, A. A. Oglobin, V. M. Pankratov, and V. P. Rudakov (U.S.S.R. Sovet Ministrov. Gosudarstevennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 8p.

A time-of-flight method was used for recording n^4 and n^6 type nuclei during ^{48}Ca bombardment by ^{12}C and ^{3}H. All observed effects were related to an incidental coincidence background production cross sections were found for n^4, $\sigma < (4 \text{ to } 6) \times 10^{-30}$ cm^2/sterad, and n^6, $\sigma < 1 \times 10^{-30}$ cm^2/sterad. (tr-auth)

24617 (NYO-1807-7) LIMITED APPLICABILITY OF NUCLEON TUNNELING THEORY. G. Breit (Yale Univ., New Haven). [1964]. Contract AT(30-1)-1807. 5p. (CONF-502-8)

From International Congress of Nuclear Physics, Paris, July 1964.

Limitations on the applicability of single nucleon transfer theory are discussed. For the special case of an isotropic transfer function such as for a s-neutron, exact reduction of the equations in a "two black boxes" theory is made. Reasons for expecting additional effects on energy and angle dependence due to extra terms are discussed including mass and field dissymmetries, acceleration, and anisotropy effects as well as angular momentum matching as affected by relative motion of heavy aggregates and interplay of virtual Coulomb excitation with wave absorption, the latter partly arising from the former, resulting in increase of effective nuclear radius. (auth)

24618 (NYO-1807-8) ANALYSIS OF NUCLEON TRANSFER DATA. G. Breit, J. A. Polak, and D. Torchia (Yale Univ., New Haven). [1964]. Contract AT(30-1)-1807. 2p. (CONF-502-7)

For Presentation at International Congress of Nuclear Physics, Paris, July 1964.

Angular distribution data on the reaction ^{14}N(^{14}N,^{13}N)^{15}N were fitted using energy-independent real and energy-dependent imaginary spin-independent potential tails in the previously developed $M/\mu = 0$ approximation. The same type of potential gave an approximate fit to ^{14}N elastic scattering by ^{14}N at laboratory energy $E_l = 21.7$ Mev. The calculated total cross section varies more rapidly than the observed cross section by a factor of about 10 from E_l = 12.3 to 18.0 Mev, indicating the presence of a specific effect such as virtual Coulomb excitation enhancing low E_l transfer. Omission of acceleration effects, spin dependence, difference in ^{14}N−^{14}N and ^{13}N−^{15}N interactions, and transfer anisotropy may contribute to the discrepancy. (auth)

24619 (NYO-10269) NUCLEAR INTERACTIONS OF 900-Mev ALPHA PARTICLES. M. V. K. Appa Rao and P. J. Lavakare (Rochester N. Y. Univ.). June 5, 1963. Contract AT(30-1)-875. 15p.

The nuclear disintegrations produced by 900-Mev alpha particles in nuclear emulsion were studied. The mean free path for alpha interaction was found to be 17.0 ± 0.8 cm. This value, together with values obtained at other energies, shows that the interaction of mean free path is energy independent. The "in-out" interaction was studied, and the probability for such an interaction was found to be 12.2 ± 1.6%. (auth)

24620 (ORNL-TM-874) NUCLEAR CROSS SECTION PROGRAM AT ORNL, JANUARY 2, 1964–June 1, 1964. H. B. Willard (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. 15p.

Studies included: parameters of low-energy neutron resonances in tungsten; nuclear radii for potential scattering for tin isotopes; neutron transmission by lead; neutron spectroscopy using the Rensselaer linac for Zr, Sn, La, and Pr; resonance scattering and absorption of gamma rays from resonance neutron capture; neutron-capture gamma measurements using a lithium-drifted germanium detector; resonance neutron capture and transmission in S, Fe, and Pb; analyses of neutron-capture gamma spectra; total cross section measurements on ^{40}Ca, ^{43}Ca, ^{57}Fe, ^{61,62,64}Ni, and ^{63,65}Cu; measurement of the yield ratio for ^{10}B(n,α)^{7}Li for ground and excited states of ^{7}Li; interactions of 350-kev polarized neutrons with oriented ^{165}Ho; fission fragment distributions for ^{230,232}Th and ^{234,236,238}U; the response of silicon solid-state detectors to heavy ions and fission fragments; resonance fission of oriented ^{235}U; differential elastic neutron scattering by ^{16}O; the inelastic neutron scattering program; alpha scattering by ^{24}Mg; coulomb excitation of ^{81}Br by alpha particles; and coulomb excitation of Cd isotopes, ^{92}Mo, and ^{119}Sn using ^{16}O ions. (R.E.U.)

24621 (PAN-449/VII) FRACTIONAL PARENTAGE COEFFICIENTS. $\langle p^n/p^{n-3}, p^3\rangle$. D. Chlebowska (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Sept. 1963. 66p.

The totally antisymmetric wave functions for the p^n configuration are transformed into the form of linear combinations of antisymmetric functions for $(n-3)$ particles vector-coupled to antisymmetric functions for the three last particles. The coefficients of this transformation are fractional parentage coefficients for three particles. They are expressed in a simple way through the coefficients for one and two particles. In the most cases the fractional parentage for three particles may be written as products of the weight factors and orbital and charge-spin coefficients. All the fractional parentage coefficients for three particles for the p^n configuration in L−S coupling are calculated. (auth)

24622 (PUC-1963-126) NUCLEAR MOMENTS OF C^{11} FROM THE $^3P_2$ AND $^3P_1$ HYPERFINE STRUCTURE (thesis). William J. Kossler, Jr. (Princeton Univ., N. J. Palmer Physical Lab.). Dec. 1963. Contract AT(30-1)-937. 203p.

Hyperfine structure separations in ^{11}C were accurately measured by the atomic beam magnetic resonance method. These separations were corrected to zero magnetic field. The ambiguity in the $^3P_1$ level ordering is discussed. The measurements lead to the hyperfine constants: $A(J = 2) = (-)\ 68.203 \pm 0.007$ Mc, $B(J = 2) = (-)\ 4.949 \pm 0.028$ Mc, $A(J = 1) = (-)\ 1.24$ Mc ± 1%, and $B(J = 1) = (+)\ 2.475$ Mc/sec ± 1%. To obtain $A(J = 1)$ a value for $\langle 1/r^3 \rangle_{av.} = 1.525 \times 10^{25}$ cm^3, and the fact that $B(J = 1) = -\frac{1}{2}B(J = 2)$ for the case at hand were used. The signs of the constants are based on the theoretically expected sign of μ_I. Percentage uncertainties are from the uncertainty in $\langle 1/r^3 \rangle_{av.}$. Using $\langle 1/r^3 \rangle_{av.}$ the nuclear magnetic dipole moment and electric quadrupole moment were obtained. The moments are considered in the light of theoretical nuclear models, in particular the intermediate coupling calculations of Kurath. During the experiment studies of the discharge, detection equipment, and overall efficiency of the machine were made and are reported. A computer program was used in the analysis of the resonances. The calculations required to go from the resonance data to the nuclear moments are discussed in detail. (auth)

24623 (UCRL-10727) SCATTERING OF 65 Mev HELIUM IONS FROM O^{16}. P. Darriulat, J. H. Elliott, B. G. Harvey, W. B. Jones, J. R. Meriwether, E. J-M. Rivet, and A. Springer (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 1963. Contract W-7405-eng-48. 32p.

In the inelastic scattering of 65-Mev helium ions by ^{16}O, the following levels of ^{16}O were excited: 6.134, 6.918, 7.118, 8.876, 9.850, 10.363, 11.083, 11.52, 12.02, 12.443 + 12.528 (unresolved), 12.968 + 13.101 (unresolved), 13.981 and 14.94 Mev. Angular distributions were obtained for the particle groups corresponding to nearly all these ^{16}O levels. The levels at 8.876, 11.083, 12.528, 12.968, 13.981 are of unnatural parity (parity $(-)^{J+1}$). At small angles the angular distributions of the 8.876-Mev 2− level oscillates in phase with the elastic angular distribution as a negative parity level should, but at angles greater than 45°, it behaves more like a positive parity level. The T = 1 levels at 12.968 and 13.101 Mev were excited about as strongly as neighboring T = 0 levels, but the T = 1 level at 13.260 Mev was not observed. All negative parity levels of the $p^{-1}(s,d)$ configuration were observed where not forbidden by selection rules or obscured by their great width. The 9-59-Mev 1− level was not observed, confirming that it is a level of three-particle excitation. The 3− level at 6.134 Mev showed collective enhancement of its cross section. (auth)

24624 (UCRL-10806) EQUILIBRIUM DISTRIBUTIONS OF EFFECTIVE CHARGES OF PRODUCTS OF HEAVY-ION-INDUCED SPALLATION. Naftali H. Steiger (California. Univ., Berkeley. Lawrence Radiaton Lab.). May 1, 1963. Contract W-7405-eng-48. 39p.

The equilibrium distributions of effective charges of heavy particles of nuclear charge $Z = 66 \pm 1$ (Tb, Dy, Ho) were studied experimentally in the velocity region from 2.5 to 6×10^8 cm/sec. The particles were produced by bombarding targets in the rare-earth region with ^{12}C, ^{14}N, ^{16}O, ^{19}F, ^{20}Ne, and ^{22}Ne ions. The resultant heavy reaction products achieve charge equilibrium before leaving the target material. Charge-state probabilities for effective charges between 3 and 33 were found. Their distribution for a certain velocity may be approximated by a normal distribution. The mean charges obtained from these distributions fit well a linear dependence on the particle velocity. The mean charge values may, for the velocity region considered, be represented by Bohr's approximate theory with the addition of a factor of two that represents the "state of condensation" effect. (auth)

24625 (WASH-1046) REPORTS TO THE AEC NUCLEAR CROSS SECTIONS ADVISORY GROUP. Meeting at E. I. Du Pont de Nemours & Co., Savannah River Laboratory, January 28–30, 1964. A. B. Smith, comp. (Argonne National Lab., Ill.). Contract [W-31-109-eng-38]. 126p. (EANDC(US)-50"U")

Developments at the various participating institutions are summarized. Neutron reactions and scattering, charged particle reactions, p-p interactions, energy levels, resonances, nuclear structure, form factors, and fission were among the topics studied. Some developments in equipment and technique are also reported. (D.C.W.)

24626 (AEC-tr-6316(p.35-41)) STUDIES ON THE DISTRIBUTION OF BETA ENERGY DISSIPATION IN ABSORBERS. I. ION CHAMBER MEASUREMENTS OF ENERGY DISSIPATION IN ALUMINUM. Yota Nakai, Harumi Izura, Koji Matsuda, and Kiichi Kimura. (Translation)

A series of precise energy dissipation distribution measurements was made using monoenergetic electron beams of 1.0, 1.5, and 1.8 Mev in aluminum in an air chamber. The results are plotted in an energy dissipation vs thickness graph; the 1.0 Mev curve agrees well with Spencer's theoretical results over the range of 200 to 300 mg/cm^2. (D.L.C.)

24627 (AEC-tr-6316(p.42-5)) STUDIES ON THE DISTRIBUTION OF BETA ENERGY DISSIPATION IN ABSORBERS. II. ION CHAMBER MEASUREMENTS OF ENERGY DISSIPATION IN BERYLLIUM. Yota Nakai, Harumi Izura, Koji Matsuda, and Kiichi Kimura. (Translation)

Beta energy dissipation curves were determined in Be using electron beams of 1.0, 1.2, 1.4, and 1.6 Mev and a parallel-plate type ion chamber. The results are compared with these for Al and C; the shift from C to Be is much greater than that from Al to C, indicating that the Spencer theory is not valid for low atomic numbers. Extrapolated and true ranges are compared for the various energies and the reasons for the differences are discussed. (D.L.C.)

24628 (AEC-tr-6316(p.59-65)) LOW-ENERGY SPECTRUM OF BETA RADIATION. Yota Nakai, Harumi Izura, Koji Matsuda, and Takenobu Higashimura. (Translation)

An electrostatic spectrometer using two aluminum plates, an aluminum foil, and means for applying an electrical potential and for measuring the electrical current, was devised for studies of low-energy spectra of electrons. An electron beam of 1.5 Mev and 5 μa was used in these studies in conjunction with absorption plates of varying thickness. The spectrum of the low-energy secondary electrons in aluminum shows a sharp peak at ~2 ev, which, when added to the surface potential function, gives a value of 6 ev. (D.L.C.)

24629 DETERMINATION OF NUCLEAR MATRIX ELEMENTS FROM THE MEASUREMENT OF ϵ/β^+. I. Montvay (Roland Eötvös Univ., Budapest). Acta Phys. Acad. Sci. Hung., 17: 185-202(1964).

The calculation of transition probabilities of β-decay in the case of forbidden transitions, mostly of higher forbidden ones, will be simpler, if matrix elements containing only the radial part of nuclear wave functions instead of the traditional reduced matrix elements are used. In this way also the ratio ϵ/β^+ can be calculated in all the cases; the measurement of the ratio ϵ/β^+ can be used for the determination of nuclear matrix elements. (auth)

24630 PAIRING CORRELATION IN THE NUCLEAR SURFACE LAYER. P. Szépfalusy (Roland Eötvös Univ., Budapest). Acta Phys. Acad. Sci. Hung., 17: 229-30(1964).

A nonuniform system of fermions in superfluid state is treated starting from the equations for the one-particle Green's function in the framework of the generalized Hartree-Fock method taking into account pairing correlation. Equations for determining the self-consistent pairing potential and expressions for the phase space density of tractable form are deduced with the aid of an approximation method, which to the lowest order gives formulas of similar form to those of infinite systems, but the one-particle effective potential, and therefore all the other quantities too, depend on the position. In that approximation the phase space density goes over into that of the Thomas-Fermi model if the pairing correlation is neglected. By taking into account first- and second-order terms inhomogeneity corrections both to the phase space density and the equations determining the pair correlation were derived. The presence of the pair correlation plays an intrinsic role in the evaluation of the correction terms to the phase space density from the Green's function. Thus the pairing correlation may have considerable effect on the density distribution. (auth)

24631 THE GROUND STATE ENERGY OF ODD FERMION SYSTEMS. J. Nemeth (Roland Eötvös Univ., Budapest and Inst. of Nuclear Research, Hungarian Academy of Sciences, Debrecen). Acta Phys. Acad. Sci. Hung., 17: 241-51(1964).

The ground-state energy of odd fermion systems is determined by the BCS approximation. An attempt is made to eliminate the error of the BCS method in the case of small particle number. (auth)

24632 FINAL STATE n–n INTERACTION IN THE THREE-PARTICLE PHOTODISINTEGRATION OF TRITON. G. Gyoergyi and P. Hrasko (Central Research Inst. of Physics, Hungarian Academy of Sciences, Budapest). Acta Phys. Acad. Sci. Hung., 17: 253-60(1964).

The cross section of the $\gamma + t \rightarrow n + n + p$ reaction was calculated, taking into account the interaction of the two neutrons in the final state. The proton spectrum is found to be sensitively dependent on the $^1S_0$ neutron-neutron scattering length in the neighborhood of its upper limit. (auth)

24633 THE STATISTICAL THEORY OF ATOMIC NUCLEI. PART V. P. Gombás and D. Kisdi (Technische Universität, Budapest and Research Group for Theoretical Physics, Budapest). Acta Phys. Acad. Sci. Hung., 17: 261-9(1964).

The density distributions of nucleons for the statistical nuclear model developed previously for various interaction energies and for Yukawa, exponential, and Gauss interactions of the nucleons are discussed. In addition, for these interactions of nucleons for nuclei, the electrostatic-equivalent nuclear radius, the thickness of the surface layer, as well as the "half-way" radius were calculated and compared. It was found that the data calculated for the exponential or Gauss interactions and the density distributions of nucleons in the case of exponential or Gauss interactions between the nucleons agree considerably better with the experimental results than in the case of Yukawa interactions. (tr-auth)

24634 SHELL MODEL CALCULATIONS OF THE ENERGY LEVELS IN K^{40}. Stanisław Szpikowski (M. Curie-Skłodowska Univ., Lublin, Poland). Acta Phys. Polon., 25: 169-77(Feb. 1964).

The matrix elements of the hole-particle interaction $V_{12} = V_0(1 + x\sigma_1 - \sigma_2)\delta(r_1 - r_2)$ are calculated in the j-j coupling scheme. On the assumption that the mixing configuration $(1f_{7/2})$ or $(2p_{3/2})$ for the loose neutron and $(1d_{3/2})$ for the proton-hole exists in ^{40}K the energies of eight levels in ^{40}K were found. The calculations are in accordance with the experimentally known spins and energies of the ^{40}K levels. (auth)

24635 THE APPLICATION OF THE VELOCITY-DEPENDENT NUCLEAR FORCES TO THE CALCULATION OF THE BINDING ENERGY OF THE ^{16}O NUCLEUS. R. Żuberek (Inst. for Nuclear Research, Warsaw). Acta Phys. Polon., 25: 277-83(Feb. 1964).

A variational calculation of the binding energy of the ^{16}O nucleus is presented. The velocity-dependent potential derived by Green is used. A one-parameter trial function in the form of the harmonic oscillator shell model wave function is assumed. The results show that the binding energy is very sensitive to changes in the relative strength of central and tensor forces. The largest binding energy obtained for the case of a strong central interaction is about 76 per cent of the experimental value. (auth)

24636 STRONG ABSORPTION MODEL FOR ELASTIC NUCLEAR SCATTERING AND POLARIZATION OF SPIN-½ PARTICLES. PART I. W. E. Frahn and R. H. Venter (Univ. of Stellenbosch, Cape Province, South Africa). Ann. Phys. (N. Y.), 27: 135-66(Apr. 1964).

The generalized strong-absorption model for elastic nuclear scattering permits a straightforward extension to describe the polarization of spin-½ particles strongly interacting with nuclei. Explicit expressions are derived for the differential scattering cross section $\sigma(\theta)$, the polarization $P(\theta)$ and the total reaction cross section σ_r. The general expressions reduce in special cases to simple formulas that describe a variety of possible structures of the polarization angular distribution, corresponding to different physical situations. The cases for "neutral" and charged particles are treated separately. The former applies to the entrance channel phenomena of protons and neutrons in the energy region $E \gtrsim 100$ Mev. The latter is expected to describe possible future polarization measurements in the elastic nuclear scattering of composite spin-½ particles such as ^3He, ^{19}F, etc. The general formalism is developed, and several special cases are considered. In two subsequent papers an analysis of a complete set of high-energy proton scattering data, and the connection between the present model and the complex potential model will be discussed. (auth)

24637 MEASUREMENT OF SHORT LIVED ISOTOPE. Junichiro Furuta, Masatoshi Fujishiro, Tamotsu Kanazawa, and Toshio Azuma. Ann. Rept. Radiation Center Osaka Prefect., 4: 83-5(1963).

A method of circulating the solution of the target element in order to measure activities as quickly as possible was used to obtain the relative cross section of the $Ag(\gamma,\gamma')$ reaction by ^{60}Co compared with that of $In(\gamma,\gamma')$. The method for $^{109}Ag(n,\gamma)^{110}Ag$ using Linac was also tried, and the gamma ray of ^{110}Ag of 660 kev and 24.5 sec was measured. The circulation method has the advantage being able to count short-lived samples in solution for a long time. The

γ-γ coincidence spectrum of ^{110}Ag was also measured using the circulation method. (P.C.H.)

24638 INFLUENCE OF FINITE DIMENSIONS OF NUCLEUS ON BETA SPECTRUM OF UNIQUE FIRST-FORBIDDEN TRANSITIONS. M. Vinduška (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Czech. J. Phys., 14: 143-51(1964). (In Russian)

The influence of the dimensions of a nucleus on the form of the spectra of unique first-forbidden transitions is investigated. The results of a theoretical analysis are compared with the experimental results. Experiments are proposed whereby the exactness of the different approximations used in the theory of beta decay could be verified. The questions have a direct relation to the proofs of the presence of weak magnetism during beta decay. (auth)

24639 RADIOACTIVE DECAY OF Ni^{65}. J. Frána and I. Řezanka (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Czech. J. Phys., 14: 152-7(1964).

The radioactive decay of ^{65}Ni was studied on a short-lens spectrometer and on a scintillation spectrometer with a two-hundred-channel amplitude analyzer. By means of a magnetic spectrometer 3 groups of the beta spectrum with energies of 2140 ± 10, 1020 ± 25, and 650 ± 30 kev with relative intensities of 58 ± 5, 11 ± 3, and 30 ± 5% were found. From gamma spectrum measurements the existence of another two beta transitions with energies of 520 and 420 kev follows. Seven transitions were found in the gamma spectrum: 370 (4.6%), 510 (0.37%), 610 (0.22%), 1115 (17%), 1480 (24%), 1620 (0.5) and 1720 kev (0.45%). Inasfar as there exist other gamma transitions, they are weaker than 0.03% at decay. (auth)

24640 STRUCTURE IN THE ENERGY DEPENDENCE OF $\bar{\nu}$. S. H. Schuster and R. J. Howerton (Univ. of California, Livermore). J. Nucl. Energy, Pt. A. & B, 18: 125-30(Mar. 1964). (UCRL-7389)

The energy dependence of the number of neutrons per fission is discussed for ^{233}U, ^{235}U, ^{238}U, and ^{239}Pu in view of recent measurements. Several basic assumptions are made which lead to better analytic representation than the previously assumed straight-line functions. (auth)

24641 COULOMB EXCITATION IN DEFORMED NUCLEI. Hans Luetken and Aage Winther. Kgl. Danske Videnskab. Selskab, Mat.-Fys. Skrifter, 2: No. 6, 1-31 (1964).

In multiple Coulomb excitations of deformed nuclei one may observe also a weaker excitation of rotational bands that are associated with states of different intrinsic structure. The excitation amplitudes of such states were computed in the approximation where one neglects the energy differences between the states of a rotational band. For the case of dipole, quadrupole, and octupole excitations the results are given. They show that the relative population of the states within a band depends strongly on the spin and K quantum numbers as well as on admixtures in the wave function of components from the ground-state band. A detailed investigation of the dependence of the cross sections on scattering angle is presented. One finds here appreciable deviations from the so-called $\chi(\vartheta)$-approximation, especially concerning the excitation of the unnatural parity states. (auth)

24642 IONOGRAPHIC STUDY OF THE REACTIONS OF NEUTRONS ON CARBON AT 15 TO 80 Mev. L. St-Pierre, M. Guinea, and S. Demers (Univ. of Montreal). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 642-4(1963). (In French)

The feasibility of using ^{9}Be(p,n) as a source of 15- to 80-Mev neutrons for studying the reaction ^{12}C(n,n′) is discussed. It is noted that the neutrons from the former reaction have a large energy spread. (T.F.H.)

24643 STUDY OF THE REACTION (n,α) ON NITROGEN BY NUCLEAR EMULSION METHODS. Cao-xuan-Chuan (Faculte des Sciences, Bordeaux). Korpuskularphot., Vortr. Diskuss. Intern. Kolloq., 4, Munich, 1962, 645-53 (1963). (In French)

Angular distributions and cross sections are measured for the reactions (n,α) on ^{14}N and ^{16}O using nuclear emulsion detectors. In addition, the range-energy relations for the residual nuclei from these reactions are presented. (T.F.H.)

24644 ENHANCED DOUBLE QUANTUM SIGNALS IN NUCLEAR MAGNETIC RESONANCE. A. D. Cohen and D. H. Whiffen (National Physical Lab., Teddington, Surrey, Eng.). Mol. Phys., 7: 449-64(1963-64).

A suggestion by Yatsiv for enhancing the strength of double quantum signals in high resolution nuclear magnetic resonance by use of r-f sidebands is examined and shown to be practical. The theory shows that double quantum techniques can be extended to weakly coupled systems of nuclei (including systems of nuclei of different isotopic species). The AX part (with J_{AX} = 5.4 c/s, $\delta_{AX}/2\pi$ = 99.2 c/s) of the proton magnetic resonance spectrum of maltol (3-hydroxy-2-methyl-γ-pyrone) serves to confirm experimentally the quantitative theoretical treatment for weakly coupled systems. An enhancement factor of eight was observed. (auth)

24645 SPIN-SPIN INTERACTIONS AND SCATTERING FROM POLARIZED NUCLEI. K. T. R. Davies and G. R. Satchler (Oak Ridge National Lab., Tenn.). Nucl. Phys., 53: 1-21(Apr. 1964).

The elastic scattering of polarized nucleons from polarized targets is studied, assuming an optical-model potential which includes an interaction of the form f(r) I • S. Numerical results, obtained using the distorted-wave Born approximation, are presented for some typical cases, namely neutrons of 0.3, 2, and 14 Mev, protons of 5 and 14 Mev incident on ^{55}Mn and ^{165}Ho target nuclei. Comparison with experiment can yield the sign and magnitude of the I • S interaction. (auth)

24646 HIGHER RANDOM PHASE APPROXIMATION APPLIED TO THE DESCRIPTION OF THE SPHERICAL VIBRATIONAL NUCLEI. Taro Tamura (Oak Ridge National Lab., Tenn.) and Takeshi Udagawa. Nucl. Phys., 53: 33-53(Apr. 1964).

The calculation of the spectra of vibrational nuclei is formulated in the framework of the higher random-phase approximation, with the primary interest in describing the two-phonon states of spherical vibration nuclei. Most of the numerical calculation was made for ^{114}Cd, where fairly good agreement with experiment was obtained. The implications of the calculation for other nuclei and possible future improvements are discussed. (auth)

24647 TENSOR POLARIZATION OF DEUTERONS SCATTERED FROM He^{4} BETWEEN 4 AND 7.5 Mev. F. Seiler, S. E. Darden, L. C. McIntyre, and W. G. Weitkamp (Univ. of Wisconsin, Madison). Nucl. Phys., 53: 65-76(Apr. 1964). (TID-19745)

The tensor polarization of deuterons scattered from ^{4}He at a laboratory angle of 60° was measured at seven deuteron energies between 4 and 7.5 Mev. The spin tensor moments $\langle T_{20}\rangle$, $\langle T_{21}\rangle$ and $\langle T_{22}\rangle$ of the scattered deuterons were determined by observing the deviation from isotropy of the protons from the $^3He(d,p)^4He$ reaction near the 430-kev resonance when the scattered deuterons initiate the reaction. Both moments $\langle T_{20}\rangle$ and $\langle T_{22}\rangle$ exhibit maxima at about 5.2-Mev deuteron energy, reaching 60% of their maximum possible values. The moment $\langle T_{21}\rangle$ remains essentially zero over the entire energy range. Comparison with available calculations is presented. (auth)

24648 THE ANGULAR DISTRIBUTION OF PROTONS FROM THE REACTIONS $Be^9(d,p)Be^{10}$, $C^{12}(d,p)C^{13}$, $O^{16}(d,p)O^{17}$, AND $Ca^{40}(d,p)Ca^{41}$ AT 11.8 Mev. U. Schmidt-Rohr, R. Stock, and P. Turek (Max-Planck-Institut für Kernphysik, Heidelberg). Nucl. Phys., 53: 77-86(Apr. 1964). (In German)

To determine the absolute total cross sections of (d,p) reactions, the angular distributions of protons from 10° to 165° were measured for the reactions $^9Be(d,p)^{10}Be$, $^{12}C(d,p)^{13}C$, $^{16}O(d,p)^{17}O$, and $^{40}Ca(d,p)^{41}Ca$. The deuteron energy was 11.8 Mev. The angular momenta of the captured neutrons were estimated by comparison of the experimental angular distributions with those calculated in the plane wave Born approximation. It is found that the neutron captured into the 7.37-Mev level of ^{10}Be contributes $l = 2$ and that, therefore, this level has negative parity. For all levels studied the reduced widths were calculated. A comparison with measurements at other energies showed that a systematic dependence of the reduced widths with energy is rarely noticeable. The reduced width of the 6.28-Mev level of ^{10}Be is $\theta^2 = 0.032$, which is considerably less than the value reported by Macfarlane. The reduced widths of $^{40}Ca(d,p)^{41}Ca$ are in better agreement with the values of Nemets et al. than with those of Macfarlane. The reduced width of the 2.47-Mev level of ^{41}Ca is relatively small which is an indication that the ^{40}Ca core is excited during the (d,p) process. (auth)

24649 AN APPLICATION OF THE SEPARATION METHOD IN SHELL-MODEL CALCULATION. A. Kallio and K. Kolltveit (NORDITA, Copenhagen). Nucl. Phys., 53: 87-96(Apr. 1964).

The odd-parity states in ^{16}O are calculated assuming a spin-dependent two-body potential with hard core. The separation method of Moszkowsky and Scott is used, and it is shown that this method is very convenient for nuclear calculations as long as harmonic oscillator wave functions can be used. (auth)

24650 (He^3,n) REACTIONS ON VARIOUS LIGHT NUCLEI. H. C. Bryant (Univ. of New Mexico, Albuquerque), J. G. Berry, E. R. Flynn, and W. T. Leland. Nucl. Phys., 53: 97-112(Apr. 1964). (LADC-5520)

Neutron spectra were obtained from reactions produced by 25-Mev ^3He particles on the nuclei ^4He, ^9Be, ^{10}B, ^{11}B, ^{12}C, ^{13}C, ^{14}N, ^{16}O, ^{19}F, ^{20}Ne, ^{27}Al, ^{40}Ar, and ^{40}Ca. These spectra were observed with a 10-cm liquid hydrogen bubble chamber. Cross sections at 0° were obtained for a neutron energy range of 5 to 35 Mev. Graphs of all spectra are shown and new energy levels given when indicated within the resolution of the bubble chamber (about 1 Mev). (auth)

24651 STATISTICAL MODEL STUDY OF PROMPT NEUTRONS FROM SPONTANEOUS FISSION OF Cf^{252}. D. W. Lang (Franklin Inst., Swarthmore, Penna.). Nucl. Phys., 53: 113-27(Apr. 1964).

Numerical data produced by Bowman, Thompson, Milton and Swiatecki from a study of neutrons in coincidence with spontaneous fission of ^{252}Cf are compared with predictions from the statistical model of nuclear reactions. The energy balance is first tested, and is found to be reliable in data regions where the statistics are best. A form of the neutron energy spectrum deduced by Le Couteur for an evaporation cascade is re-derived under more general conditions, giving a closer description of actual nuclear properties. The experimental form of the energy spectrum is in close agreement. Values of the level density parameter a are calculated from the data and agree with measurements made in other experiments. (auth)

24652 INELASTIC EFFECTS IN STRIPPING AND OTHER DIRECT REACTIONS. S. K. Penny and G. R. Satchler (Oak Ridge National Lab., Tenn.). Nucl. Phys., 53: 145-58(Apr. 1964).

The distorted-wave theory of direct nuclear reactions, such as deuteron stripping, is generalized to include in the distorted waves the effects of the strong inelastic scattering which may be present when the nuclei show collective behavior. The possible changes in parity and angular momentum selection rules are discussed in detail. Formulas are given for the general case, and also for a simple model in which only one level of the target nucleus (assumed even) can be excited. (auth)

24653 THE SPIN RELAXATION IN X-GAMMA ANGULAR CORRELATIONS. D. Dillenburg and Th. A. J. Maris (Universidade do Rio Grande do Sul, Pôrto Alegre, Brazil). Nucl. Phys., 53: 159-64(Apr. 1964).

Relations between the expansion coefficients of the angular correlation function of a statistically perturbed X-gamma decay are derived, and some examples are discussed. (auth)

24654 A STUDY OF NONMESIC HYPERFRAGMENTS WITH $Z \geq 3$ USING PRODUCTION ANALYSIS. M. W. Holland (Northwestern Univ., Evanston, Ill.). Nuovo Cimento (10), 32: 48-63(Apr. 1, 1964).

Hyperfragments with charge (Z) ≥ 3, produced by K^- capture in an emulsion stack, were studied using production analysis as an aid in hyperfragment identification. On the basis of 96 nonmesic decays and 30 π^- mesic decays, the overall nonmesic to π^- mesic decay ratio was found to be 3.2 ± 0.7. By separating the events according to production characteristics, the nonmesic to π^- mesic ratios for the $3 \leq Z \leq 4$ group (R_L) and the $Z \geq 5$ group (R_H) were measured. The results are compared with theoretical calculations made by Dalitz for some selected hyperfragments. The reliability of kinematic analysis of hyperfragment productions was also considered and the charge production pion spectrum was determined. In addition, hyperfragment decay products was examined to study the Λ stimulation process. (auth)

24655 PHOTOFISSION OF Bi, W AND Ag FROM 300 to 1000 Mev. H. G. de Carvalho (Università, Naples and Instituto Nazionale di Fisica Nucleare, Naples), G. Cortini, E. Del Giudice, G. Potenza, R. Rinzivillo, and G. Ghigo. Nuovo Cimento (10), 32: 293-7(Apr. 16, 1964).

The fission of Bi, W, and Ag induced by (300 to 1000)-Mev photons was studied. Nuclear emulsions, loaded with known amounts of suitable salts of the fissionable elements were used. The cross section per photon and the fissility were obtained. (auth)

24656 Λ-Λ-BINDING IN LIGHT HYPERNUCLEI. P. S. Damle and S. N. Biswas (Tata Inst. of Fundamental Research, Bombay). Nuovo Cimento (10), 32: 381-7(Apr. 16, 1964).

Using the fact that Λ-Λ interaction in $^1S_0$-state is about as attractive as the Λ-Λ interaction, possible binding of double Λ with light nuclei were considered assuming the

Dalitz and Downs parameters for Λ-nucleon forces. Calculations based upon variational techniques with a suitable trial wave function for the 3-body model of $_{\Lambda\Lambda}^{6}He$ and $_{\Lambda\Lambda}^{5}He$ show that these systems are bound. Further, it is indicated that even with a weakly repulsive Λ-Λ-potential, $_{\Lambda\Lambda}^{6}He$ is bound, in agreement with what Dalitz and Downs pointed out before. Finally, the use of the same trial wave function in the variation principle for Λ-Λ-nucleon system shows that Λ-Λ-nucleon bound system is unlikely with the present knowledge about the forces. (auth)

24657 ON THE DECAY OF THE 4-HOUR ACTIVITY OF ^{71}Zn. P. N. Tandon and H. G. Devare (Tata Inst. of Fundamental Research, Bombay). Nuovo Cimento (10), 32: 388-95(Apr. 16, 1964).

The γ spectrum of ^{71}Zn was studied with a scintillation spectrometer. New γ rays of energies 760, 950, 1100, 1280, and 1440 kev were observed apart from the previously known γ rays of energies 390, 490, and 610 kev. Relative intensities of these γ rays were found by analyzing the γ spectrum. From the sum peaks observed in the total absorption γ-ray spectrum and coincidences between various γ rays, new levels were proposed in ^{71}Ga at 2250, 2440, 2600, 2770, and probably also at 1830 kev. Relative intensities of the β groups feeding various levels in ^{71}Ga were estimated from the relative intensities of the γ rays. Spin and parity assignments to the various levels were suggested consistent with the log ft values of the β groups feeding them and also their decay modes. (auth)

24658 ON MUON CAPTURE IN HEAVY NUCLEI. J. S. Bell and J. Loevseth (CERN, Geneva). Nuovo Cimento (10), 32: 433-47(Apr. 16, 1964).

The theory of the Primakoff plot is developed in a simple way. Corrections advocated by Klein and Wolfenstein are shown to be absent when reasonable correlation functions, such as those of the ideal Fermi gas, are used. However, development of the gas model throws doubt on the accuracy of the theory. The excellent agreement with experiment must be in part accidental. (auth)

24659 A NEW USE OF THE KRONIG-KRAMERS RELATIONS IN NUCLEAR MAGNETIC RESONANCE. H. C. Bolton, G. J. Troup, and G. V. H. Wilson (Monash Univ., Victoria, Australia). Phil. Mag. (8), 9: 591-605(Apr. 1964).

Many weak or readily saturable nuclear magnetic resonances can be detected only by the use of the dispersion mode in a nuclear induction system, and dispersion records of complicated or partially resolved spectra may be difficult to interpret. However, it is shown that, for systems obeying Bloch or Redfield equations, the Kronig-Kramers (K-K) relations may be used justifiably to transform a dispersion record taken in the presence of saturation, under slow modulation conditions, into the more readily interpretable absorption record. The K-K relations are shown to apply to the derivatives of the absorption and dispersion line shapes, which are the quantities usually recorded, and to transform a modulation-broadened dispersion curve into the appropriate modulation-broadened absorption curve. The relations hold for derivatives of any order and may, therefore, be applied to records from an apparatus employing phase-sensitive detection at any harmonic of the modulation frequency. Results are presented for some analytical cases, and details of the computational method are given. Simple trapezoidal integration is found to yield high accuracy. The resonance of ^{9}Be in beryl is used to confirm the applicability of the K-K relations in the presence of saturation. (auth)

24660 TENTATIVE LEVEL SCHEMES OF Mn^{51} AND Mn^{53}. S. E. Arnell and S. Sterner (Chalmers Univ. of Tech., Göteborg). Phys. Letters, 9: 319-21(May 1, 1964).

The proton-capture gammas from resonances in the reactions $^{50}Cr(p,\gamma)^{51}Mn$ and $^{52}Cr(p,\gamma)^{53}Mn$ were studied to obtain information about the level schemes of ^{51}Mn and ^{53}Mn. (R.E.U.)

24661 LOCATION OF THE 4^- LEVEL IN Zr^{90}. D. L. Hendrie and G. W. Farwell (Univ. of Washington, Seattle). Phys. Letters, 9: 321-4(May 1, 1964).

A hypothesis that the 4^- level probably forms an unresolved doublet with the collective 3^- level at 2.75 Mev, and that its excitation by neutron inelastic scattering accounts for the gamma transition to the 5^- level, which has been observed, is borne out through the observation of de-excitation gammas in coincidences with inelastically scattered alpha particles, which have excited the 2.75-Mev levels. (R.E.U.)

24662 POLARIZATION OF GAMMA RAYS FROM THE $Si^{30}(p,\gamma)P^{31}$ REACTION AND THE 9.42 AND 4.43 Mev LEVELS OF P^{31}. G. I. Harris and H. J. Hennecke (Aerospace Research Labs., Wright-Patterson AFB, Ohio). Phys. Letters, 9: 324-7(May 1, 1964).

Spins and multipole mixing of resonances were investigated by measuring the polarization of gamma rays from proton irradiated ^{30}Si. (R.E.U.)

24663 THE 4^- STATE IN Zr^{90}. R. B. Day, A. G. Blair, and D. D. Armstrong (Los Alamos Scientific Lab., N. Mex.). Phys. Letters, 9: 327-9(May 1, 1964). (LADC-6319)

The 4^- level in ^{90}Zr was definitely identified and confirmed to be located at an excitation energy of 2.75 Mev using the reaction $^{89}Y(^{3}He,d)^{90}Zr$. (R.E.U.)

24664 PERTURBATION THEORY FOR THE CREATION OF DEUTERONS FROM HIGH ENERGY PROTON BOMBARDMENT OF MATTER. S. T. Butler (Univ. of Sydney) and C. A. Pearson. Phys. Letters, 9: 330-1(May 1, 1964).

Perturbation calculations on the pairing of a neutron and proton produced in cascade from nuclei bombarded by 25 to 30-Bev proton beams are reviewed; momentum distributions are derived and formation probabilities are investigated. Results are given for aluminum. (R.E.U.)

24665 ELASTIC SCATTERING OF 55 Mev PROTONS BY HEAVY NUCLEI. H. Kamitsubo, H. Ohnuma, K. Ono, A. Uchida, M. Shinohara, M. Imaizumi, and S. Kobayashi (Tokyo Univ.). Phys. Letters, 9: 332-3(May 1, 1964).

Elastic differential cross sections for the scattering of 55-Mev protons by heavy nuclei were measured systematically to get optical potential parameters and to investigate the role of deformation on them. Targets employed were La, Gd, Tb, Dy, Ho, Tm, Yb, Ta, W, Au, Bi, and Sm. (R.E.U.)

24666 COUPLED-CHANNEL ANALYSIS OF THE SCATTERING OF PROTONS BY Ho^{165} AND Gd^{156}. T. Tamura (Oak Ridge National Lab., Tenn.). Phys. Letters, 9: 334-6(May 1, 1964).

A code was developed for coupled-channel analyses of scattering of spin−0 or −½ particles by odd-A nuclei. The calculations are outlined and results are given for proton scattering by ^{165}Ho and ^{156}Gd. (R.E.U.)

24667 "FINITE-RANGE" EFFECTS IN THE DISTORTED-WAVE THEORY OF STRIPPING REACTIONS. R. M. Drisko and G. R. Satchler (Oak Ridge National Lab., Tenn.). Phys. Letters, 9: 342-5(May 1, 1964).

Results are presented for the application of finite-range to the distorted-wave theory of direct nuclear reactions.

Predictions are given for $^{40}Ca(d,p)$ at 11 Mev, $^{40}Ca(d,^3He)$ at 21 Mev, $^{90}Zr(p,\alpha)$ at 22 Mev, and $^{40}Ca(d,\alpha)$ at 7.7 Mev. (R.E.U.)

24668 CIRCULAR POLARIZATION MEASUREMENTS IN Eu^{154}. Richard T. Castle and Roger W. Finlay (Ohio Univ., Athens). Phys. Rev., 134: B929-31(June 8, 1964).

The circular polarization of the 1.28-Mev gamma ray following the beta decay in ^{154}Eu was measured by means of the transmission method. The anisotropy coefficient A was found to be $A = -0.21 \pm 0.07$, which gives the M2 to E1 multipolarity admixture as $\delta = -0.07 \pm 0.08$ (standard deviations). This together with other information implies the K value for the 1.4-Mev level in ^{154}Gd is K = 1. (auth)

24669 PARTIAL-WAVE ANALYSIS OF THE INELASTIC SCATTERING OF ELECTRONS BY NUCLEI. III. SYSTEMATICS OF ELECTRIC MULTIPOLE EXCITATION. D. S. Onley, J. T. Reynolds, and L. E. Wright (Duke Univ., Durham, N. C.). Phys. Rev., 134: B945-52(June 8, 1964).

The distorted-wave method for inelastic electron scattering is applied to a range of nuclei displaying electric multipole excitations under electron bombardment. It is found that a phenomenological vibrator model of the nucleus can, to a large extent, account for the behavior of the electron inelastic cross sections available from experiment, although, in many cases, the measured points cover an insufficient range of momentum transfer to make distinct the mode of vibration to be attributed to the excited nucleus. (auth)

24670 FISSION BARRIER OF THALLIUM-201. Donald S. Burnett, Raymond C. Gatti, Franz Plasil, P. Buford Price, Wladyslaw J. Swiatecki, and Stanley G. Thompson (Univ. of California, Berkeley). Phys. Rev., 134: B952-63 (June 8, 1964). (UCRL-11079)

A new method involving the detection of fission fragments in mica was applied to the measurement of the fission cross section of the compound nuclus ^{201}Tl produced by bombardments of ^{197}Au with helium ions. These data were interpreted in terms of an expression for the ratio of fission to neutron-emission probabilities similar to those used conventionally, but modified to include the effect of quantum-mechanical barrier penetrability. In this way a height of 22.5 ± 1.5 Mev was found for the fission barrier of ^{201}Tl and a lower limit on the width could be established. The above value of the barrier, when interpreted on the basis of the liquid-drop theory, leads to an accurate determination of the ratio of the electrostatic to the surface energy of nuclei. This serves to establish the constant of proportionality between the "fissionability parameter" x and the value of Z^2/A as follows: $x = (Z^2/A)/(48.4 \pm 0.5)$. This measured barrier height, when added to the ground-state mass of ^{201}Tl, gives a saddle-point mass of this nucleus equal to 200.9949 ± 0.0015 mass units (carbon scale). (auth)

24671 EXCITATION OF THE GIANT RESONANCE IN C^{12} AND O^{16} BY INELASTIC ELECTRON SCATTERING. J. Goldemberg and W. C. Barber (Stanford Univ., Calif.). Phys. Rev., 134: B963-71(June 8, 1964).

The excitation of the electric-dipole giant resonance in ^{12}C and ^{16}O was studied by measuring the spectrum of electrons inelastically scattered at 180°. Experiments were made with incident electrons of 40, 55, and 70 Mev; combining these data with the known photon absorption cross section a form factor for the giant resonance cross section is obtained for momentum transfers up to 120 Mev/c. The form factor for the combined strength of the main giant resonance in ^{12}C and ^{16}O, which is concentrated between 20 and 25 Mev, has a very characteristic shape going through a shallow minimum and increasing again with the momentum transfer. A comparison of the data with calculations of Lewis and Walecka using an extended shell model of the giant resonance indicates quantitative agreement, while collective models (such as the Goldhaber-Teller and Steinwedel-Jensen) fail to explain the data. The cross sections display also some fine structure. In ^{12}C peaks are seen at 18.1, 19.5, 24, and 34 Mev; in ^{16}O the peaks are at 19, 22.5, and 25.5 Mev. (auth)

24672 (d,He^3) REACTION ON Ca^{40} AND THE TITANIUM ISOTOPES. J. L. Yntema (Argonne National Lab., Ill.) and G. R. Satchler. Phys. Rev., 134: B976-84(June 8, 1964).

The $(d,^3He)$ reaction on ^{40}Ca and isotopically enriched targets of ^{46}Ti, ^{47}Ti, ^{48}Ti, ^{49}Ti, and ^{50}Ti was investigated. Absolute differential cross sections for a number of transitions were obtained over an angular range from 11 to 33°. The angular distributions are compared with distorted-wave calculations that use the optical-model-potential parameters derived from the elastic scattering of 21-Mev deuterons on the same target materials. The data for the elastic scattering are given together with the optical-model fits. The $^{40}Ca(d,^3He)^{39}K$ reaction was used to obtain the normalization coefficients necessary to extract spectroscopic factors from the comparison of the measured and calculated differential cross sections. The results show that the excitation energies of the $d_{3/2}$ and $s_{1/2}$ proton-hole states are surprisingly low and increase with the number of $f_{7/2}$ neutrons in the nucleus. In the case of ^{45}Sc, the $d_{3/2}$ hole state, which contains the full $d_{3/2}$ strength, is found at an excitation energy of less than 50 kev. The excitation energy of the $d_{3/2}$ hole state increases to 800 kev for ^{47}Sc and to about 2.4 Mev in ^{49}Sc. The excitation energy of the $s_{1/2}$ hole state increases from 0.92 Mev in ^{45}Sc to 2.1 Mev in ^{49}Sc. (auth)

24673 NEUTRON RESONANCE SPECTROSCOPY. III. Th^{232} AND U^{238}. J. B. Garg, J. Rainwater, J. S. Petersen, and W. W. Havens, Jr. (Columbia Univ., New York). Phys. Rev., 134: B985-1009(June 8, 1964).

The neutron total cross sections for ^{232}Th and ^{238}U were measured from about 100 ev to 4 kev with ~0.5 nsec/m resolution at the highest energies. The mean level spacings for these nuclei were observed to be (17.5 ± 0.7) and (17.7 ± 0.7) ev. For ^{238}U about 17% of the observed levels probably belong to $l = 1$ and are omitted from the statistical analysis of the data. S-wave strength functions of $(0.69 \pm 0.07) \times 10^{-4}$ and $(0.90 \pm 0.10) \times 10^{-4}$ are obtained for ^{232}Th and ^{238}U, respectively. Detailed comparisons of the observed statistical aspects of the level spacings and neutron reduced width distributions were made with the predictions of various theoretical models. The distributions of Γ_n^0 for both nuclei seem to be consistent with a single-channel Porter-Thomas distribution. The observed distributions of nearest and next-nearest neighbor level spacings agree quite well with the expected distributions for real symmetric hamiltonian matrices with randomly distributed matrix elements. The correlation coefficients for ^{232}Th and ^{238}U are, respectively: (a) (-0.21 ± 0.07) and (-0.26 ± 0.08) for adjacent level spacings, (b) (-0.03 ± 0.07) and (-0.17 ± 0.07) for adjacent reduced neutron widths, and (c) (0.12 ± 0.07) and (0.15 ± 0.07) for the neutron reduced width of a level and the average of its spacing from adjacent levels. (auth)

24674 NUCLEUS-NUCLEUS LONG-RANGE INTERACTION POTENTIAL IN ELASTIC SCATTERING. J. S. McIntosh, S. C. Park, and G. H. Rawitscher (Yale Univ., New Haven). Phys. Rev., 134: B1010-21(June 8, 1964). (TID-20164)

Differential cross sections are calculated for the elastic scattering of heavy nuclei by heavy nuclei and the results are compared with experiment. The long-range part of the nucleus-nucleus interaction is assumed to be representable by a two-body potential, and the attempt is made to calculate the latter in terms of the experimentally determined nucleon-nucleus optical-model potential extrapolated to negative energies and an adjustable reduced width parameter that determines the probability of finding individual nucleons at the surface of each nucleus. The short-range part of the nucleus-nucleus interaction is represented schematically by a complex potential or an ingoing wave boundary condition, the justification for which as a representation of the optical-model potential is given. Reasonable agreement with experiment is obtained for the experimental data considered, i.e., those for $^{12}C-^{16}O$, $^{14}N-^{14}N$, and $^{12}C-^{14}N$ if the average-reduced-width parameter equal to about $\frac{1}{5}$ the corresponding single-particle value is employed. (auth)

24675 FORM FACTORS FOR STRONG M1 TRANSITIONS IN LIGHT NUCLEI. J. Goldemberg, W. C. Barber, F. H. Lewis, Jr., and J. D. Walecka (Stanford Univ., Calif.). Phys. Rev., 134: B1022-4(June 8, 1964).

Strong peaks corresponding to magnetic-dipole excitation of the nucleus were observed in the energy spectrum of electrons scattered at 180° from targets of ^{6}Li, C, Mg, and Si. The momentum transfer dependence of the excitation of these peaks was investigated by using primary electrons of 40, 55, and 70 Mev. From the measured cross sections and the Born approximation theory the inelastic form factors can be obtained. The radiative transition probability from the excited state to the ground state gives the first point on the curve of form factor as a function of momentum transfer. In the case of ^{12}C, a shell-model theory of the magnetic-dipole transition gives a form-factor curve in fair agreement with the experimental results. (auth)

24676 FORM FACTORS FOR MAGNETIC-DIPOLE ELECTRON SCATTERING. Dieter Kurath (Argonne National Lab., Ill.). Phys. Rev., 134: B1025-7(June 8, 1964).

Transition probabilities were calculated for magnetic-dipole transitions excited by inelastic scattering of electrons of ^{6}Li and ^{12}C. The form factors are found to be quite insensitive to the degree of spin-orbit coupling. The harmonic-oscillator length parameters determined from fitting experimental form factors tend to be larger than those determined from charge scattering. (auth)

24677 INDEPENDENT FISSION YIELD OF Sb^{127}. David E. Troutner (Univ. of Missouri, Columbia), Arthur C. Wahl, and Robert L. Ferguson. Phys. Rev., 134: B1027-9 (June 8, 1964).

The fractional independent yield of ^{127}Sb was found to be 0.057 ± 0.010 from the thermal-neutron fission of ^{235}U. This value leads to a calculated value of 49.5 ± 0.1 for the "most probable charge" Z_P for fission products with A = 127 and implies that there is no pronounced effect of the 50-proton shell on the Z_P function. It was also found that $40.4 \pm 2.4\%$ of fission product ^{127}Sb is formed by beta decay of 4.4-min. ^{127}Sn and that $53.9 \pm 2.1\%$ is formed by beta decay of 2.15-h. ^{127}Sn. (auth)

24678 TOTAL NEUTRON CROSS SECTION OF MANGANESE. R. E. Coté, L. M. Bollinger, and G. E. Thomas (Argonne National Lab., Ill.). Phys. Rev., 134: B1047-51 (June 8, 1964).

The total neutron cross section of manganese was measured from 0.01 ev to about 50 kev, and a multilevel analysis of the data from 0.01 ev to 15 kev was carried out. This analysis shows that the strength function is $\overline{\Gamma}_n^0/D = 9.5 \times 10^{-4}$ and that the potential-scattering amplitude for the $J = 3$ series of levels is substantially less than 4 F. (auth)

24679 HIGHER ORDER SPACING DISTRIBUTIONS FOR A CLASS OF UNITARY ENSEMBLES. David Fox and Peter B. Kahn (State Univ. of New York, Stony Brook). Phys. Rev., 134: B1151-5(June 8, 1964).

The nth-order spacing distribution, $P^n(s)$, is considered in the statistical theory of energy levels of complex systems. Each P^n is written as a sum of multiple integrals over correlation functions. This procedure is used to establish the identity of the spacing distributions for all members of a class of hamiltonian unitary ensembles. A power-series expansion of $P^n(s)$, valid for all n, is developed. (auth)

24680 PRODUCTION OF A BEAM OF POLARIZED NEGATIVE HYDROGEN IONS. W. Gruebler, W. Haeberli, and P. Schwandt (Univ. of Wisconsin, Madison). Phys. Rev. Letters, 12: 595-7(May 25, 1964).

The question of whether a beam of negative hydrogen ions with nuclear polarization can be produced by charge exchange of polarized positive ions, and to what extent the polarization diminishes in the charge-exchange process, is investigated. An experiment, carried out with deuterium ions for the production of polarized negative ions, is described. The tensor polarization, P_{33}, of the resulting 100-kev deuterons, which was obtained from anisotropy measurements of the alpha particles in the $T(d,n)^4He$ reaction, was found to be -0.26 ± 0.02. It is also demonstrated that little or no depolarization takes place in the formation of negative deuterium ions. (L.B.S.)

24681 THE MASS EFFECT CORRESPONDING TO THE ONSET OF NUCLEAR DEFORMATION IN THE REGION $N \sim 90$. R. C. Barber, H. E. Duckworth, B. G. Hogg, J. D. Macdougall, W. McLatchie, and P. Van Rookhuyzen (McMaster Univ., Hamilton, Ont.). Phys. Rev. Letters, 12: 597-600(May 25, 1964).

New data obtained with a high-resolution spectrometer are combined with existing data to study the mass effect associated with nuclear deformation. Double-neutron separation energies for even-A nuclides are tabulated and plotted as a function of neutron number. The resulting curves are discussed. (L.B.S.)

24682 COULOMB WAVE FUNCTIONS FOR LOW ENERGIES. A. S. Meligy (Univ. of Alexandria, Egypt). Proc. Cambridge Phil. Soc., 60: 209-15(Apr. 1964).

The irregular radial Coulomb wave function is expanded in a convergent series of Bessel functions in which the coefficients are expressed in powers of the energy and the argument of the Bessel functions depends on the radius only and not on the energy. This formulation is suitable for low-energy particles. The corresponding expansion for the regular Coulomb function can be derived from previous work by Tricomi. (auth)

24683 LIFETIME MEASUREMENTS IN Sb^{121}. M. K. Ramaswamy (Karnatak Univ., Dharwar, India) and B. A. Bishara. Proc. Indian Acad. Sci., Sect. A, 59: 141-52 (Mar. 1964).

By means of delayed coincidence techniques, lifetime measurements were carried out in the decay of ^{121}Te to decide between two alternative level schemes for ^{121}Sb. Results support the scheme proposed by Gupta which consists of excited levels in ^{121}Sb at 70 and 576 kev. (auth)

24684 THE STRUCTURE OF NUCLEI. Victor F. Weisskopf (CERN, Geneva). Proc. Natl. Acad. Sci. U. S., 51: 971-7(May 1964).

The theory of nuclear structure is outlined by means of analogy to atomic structure. (C.E.S.)

24685 EVEN PARITY LEVELS OF MASS 18 NUCLEI. B. H. Flowers and D. Wilmore (Univ. of Manchester, Eng.). Proc. Phys. Soc. (London), 83: 683-99(May 1964).

A shell model study of the even parity levels of ^{18}O and ^{18}F is made in the light of recent data. Particular attention is paid to the sensitivity of the results to assumptions regarding the exchange mixture and the shell model potential. Overall agreement with experiment is reasonable. Even when allowance was made for collective enhancement, however, difficulties remain in understanding certain E2 transition probabilities. A 3^+ level is predicted in ^{18}O at an excitation energy of around 5 Mev. (auth)

24686 FINITE RANGE EFFECTS IN DEUTERON STRIPPING PROCESSES. P. J. A. Buttle and L. J. B. Goldfarb (Univ. of Manchester, Eng.). Proc. Phys. Soc. (London), 83: 701-17(May 1964).

Estimates are made of the error involved in the usual deuteron stripping calculation, which proceeds by means of the zero-range approximation. The finite-range effect may be simulated by maintaining the form of the zero-range calculation, but by multiplying the wave function of the captured neutron by a simple factor involving the optical-model potentials of the proton and deuteron, the potential describing the neutron binding and the binding energy of the deuteron. Numerical calculations, referring to the reactions $^{24}Mg(d,p)^{25}Mg$, and $^{52}Cr(d,p)^{53}Cr$, show that the effect on the angular distribution is very small. (auth)

24687 THE THREE-NUCLEON STRIPPING PROCESS. M. El-Nadi and H. Sherif (Cairo Univ. and Atomic Energy Establishment, Cairo). Proc. Phys. Soc. (London), 83: 719-29(May 1964).

Two alternative procedures are used to calculate the three-nucleon stripping cross section. In the first approach harmonic oscillator wave functions are used to describe the bound states of the captured nucleons. In the second approach the overlap integral is expanded in terms of a complete set of harmonic oscillator wave functions. The final formulas are obtained both with and without the introduction of the surface assumption. The surface formulas are similar to those derived before. The non-surface formulas are compared with experimental data, and satisfactory agreement is observed. (auth)

24688 THE TEMPERATURE DEPENDENCE OF THE NUCLEAR MAGNETIC RESONANCE OF VANADIUM. L. E. Drain (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Phys. Soc. (London), 83: 755-62(May 1964).

Measurements were made of the line width, intensity and shift of the ^{51}V magnetic resonance from vanadium metal over the range 25-330°K. The absence of any detectable anomalies in these properties shows that the transition at around 250°K cannot be associated with the occurrence of antiferromagnetism unless the fluctuation frequency of the internal magnetic fields exceeds 2×10^{12} c/s. From consideration of nuclear electric quadrupole interactions, it is estimated that any deviation from cubic crystal symmetry at or below the transition point is less than 2 parts in 10^3. The Knight shift increases from 0.571% at 25°K to 0.580% at 330°K with an accuracy to ±0.001%. From a comparison of the temperature dependence of Knight shift and magnetic susceptibility, the hyperfine field at a vanadium nucleus due to one d-electron spin was estimated to be −112 ± 17 kilogauss. (auth)

24689 REACTIONS OF HEAVY ELEMENTS WITH MULTICHARGED IONS. II. YIELD OF CERTAIN CALIFORNIUM AND FERMIUM ISOTOPES BY O^{16}, O^{18}, AND Ne^{22}. I. Brandshtetr, V. V. Volkov, V. A. Ermakov, T. S. Zvarova, M. Krzhivanek, Ya. Maly, and Hung-kuei Su. Radiokhimiya, 5: 706-11(1963). (In Russian)

The yields of ^{246}Cf, ^{250}Fm, and ^{252}Fm in the irradiation of ^{238}U and ^{232}Th by ^{16}O, ^{18}O, and ^{22}Ne according to the reactions: $^{232}Th + ^{18}O \rightarrow ^{246}Cf + 4n$, $^{238}U + ^{16}O \rightarrow ^{250}Fm + 4n$, $^{232}Th + ^{22}Ne \rightarrow ^{250}Fm + 4n$, $^{238}U + ^{16}O \rightarrow ^{246}Cf + \alpha 4n$, and $^{238}U + ^{22}Ne \rightarrow ^{252}Fm + \alpha 4n$ were studied. Using 15- to 20-μ-thick metallic U or Th foils. Correlations were made of effective cross sections of various isotopes produced on various targets by various particles. Correlations of previously measured effective cross sections for ^{250}Fm formation in 4n reactions during Pu irradiation by C and U by O and the data for ^{246}Cf showed that the combination of the heaviest target with the lightest particle produced the largest cross sections. Comparisons of ^{246}Cf yields from ^{238}U irradiation with ^{16}O with ^{250}Fm yields showed that the main portion of ^{246}Cf is formed in (α4n) reactions. It is assumed that the main portion of ^{252}Fm produced in ^{238}U irradiation with ^{22}Ne is also related to (α4n) reactions. (R.V.J.)

24690 DETERMINATION OF THE YIELD OF FISSION FRAGMENTS FROM HEAVY NUCLEUS FISSION BY MULTICHARGED IONS. I. FISSION OF Th^{232} BY O^{18} AND Ni^{22}. I. Brandshtetr, Tung-seng Wang, V. A. Ermakov, I. Zvara, T. S. Zvarova, V. Knoblokh, M. Krzhivanek, Ya. Maly, and Hung-kuei Su. Radiokhimiya, 5: 715-20 (1963). (In Russian)

Formation cross sections were determined for heavy lanthanides formed in ^{232}Th reactions with ^{18}O and ^{22}Ne. Studies of the yields of Y, La, and lanthanides to ^{163}Tb showed that with increasing excitation energy the yields increase. (R.V.J.)

24691 A STUDY OF RARE EARTH SPALLATION PRODUCTS. A. K. Lavrukhina and G. M. Kolesov. Radiokhimiya, 6: 62-6(1964). (In Russian)

A natural mixture of Eu, Sm, and Nd isotopes was irradiated with 660-Mev protons, and the yield of neutron-deficient radioactive rare earths by a (p,ypxn) reaction was determined. The rare earths were separated chromatographically, and counted on a 4 π NaI(Tl) scintillation counter. Gamma scans were taken on a 100-channel analyzer. Then radioactive isotopes were identified by half life, radiation energy, and type of decay. The formation of ^{24}Na in aluminum foil by $^{27}Al(p,3pn)^{24}Na$ reactions was used as a monitor. The cross section of this reaction is 10 mbarns. The activation cross sections varied from 1 to 60 mbarns for La, Ce, Pr, Nd, Pm, Sm, and Eu isotopes. Maximum yields of 10 to 60 mbarns were observed for the neutron-deficient isotopes of ^{131}La, ^{134}Ce, ^{137}Pr, ^{139}Nd, ^{141}Pm, ^{142}Sm, and ^{144}Eu. The activation cross section for other isotopes could be predicted from a graphical plot of cross section versus the atomic weight of the rare earth product. The yield of ^{134}Ce and ^{139}Pr from a Nd target was a factor of 2 to 4 greater than from a Eu target, and a factor of 20 to 30 greater than from a Hf target. Because of their ease of reduction, Sm and Eu could be separated from other induced rare earth activities by electrolytic reduction on a mercury cathode with a total surface of 44 cm² at a current density of 100 mamps/cm² and a voltage of 9 to 11 volts in a citric acid solution with a pH = 5.8 to 6.0 and a temperature of 0 to 3°C. (TTT)

24692 A NEW TREATMENT OF PAIRING FORCE IN NUCLEI. I. PAIRING CORRELATION BETWEEN LIKE NUCLEONS IN STRONGLY DEFORMED NUCLEI. Li-ming Yang (Peking Univ.). Sci. Sinica (Peking), 13: 563-70(Apr. 1964).

A method of treating the pairing force problem in nuclei, which conserves the number of particles, is presented. The exact characteristic equation of a many-pair system is put in a form similar to that of a one-pair system. Successive approximations to the many-pair wave functions similar in form to the one-pair wave function are also given. (auth)

24693 ON THE THEORY OF EXCITATION OF ZERO SOUND IN NUCLEAR MATTER. I. V. Simenog (Inst. of Physics, Kiev). Ukr. Fiz. Zh., 9: 128-38(Feb. 1964). (In Ukrainian)

The excitation of collective oscillations in nuclear matter was investigated within the framework of Landau's theory of Fermi-fluid. It was found that in such a system sonic vibrations ("zero" sound) of two types are possible. The intensity of isospin sound is higher by one order than that of dense sound. It is shown that the results of Glassgold, et al. and Hatano, corresponding to the summation of some diagrams are not directly related to systems of strongly interacting particles. (auth)

24694 POLARIZATION EFFECT IN NEUTRON SCATTERING ON NUCLEI WITH ROTATION AND VIBRATION SPECTRA. V. S. Ol'khovskii and Yu. V. Tsekhmistrenko (Kiev State Univ. and Inst. of Physics, Kiev). Ukr. Fiz. Zh., 9: 220-3(Feb. 1964). (In Ukrainian)

Effective potentials were used for describing the polarization of elastic and inelastic scattering of neutrons on ^{56}Fe, ^{24}Mg, and ^{48}Ti nuclei with rotation and vibration spectra at 1 to 3 Mev. (R.V.J.)

24695 PHOTOPROTONS FROM Li^6. E. D. Makhonovskii (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksperim. i Teor. Fiz., 46: 1136-8(Mar. 1964). (In Russian)

The distribution in energy and angle of protons resulting from the exposure of ^{6}Li to gamma rays with a maximum energy of 20 Mev was obtained with the use of nuclear photographic plates exposed in a vacuum chamber at angles of 20, 50, 70, 90, 110, 130, and 160° with respect to the incident gamma rays. The target had a thickness of 6.8 mg/cm^2 and consisted of 90% ^{6}Li and 10% ^{7}Li. The energy distribution is presented. It was concluded that the integrated ^{6}Li(γ,p)^{5}He cross section from 11.6 to 20 Mev is 3.2 ± 0.3 mb-Mev. The integrated ^{6}Li(γ,p)^{5}He cross section from 4.7 to 19 Mev is 4.9 ± 0.6 mb-Mev. The integrated ^{6}Li(γ,n)^{5}Li cross section is larger, 9.2 ± 4.3 mb-Mev, from 5.7 to 19 Mev. The portion of all reactions resulting in deuterons, tritons, and ^{3}He nuclei is discussed. (TTT)

24696 THE HALF LIFE OF Tb^{157}. E. P. Grigor'ev (Leningrad State Univ.). Zh. Eksperim. i Teor. Fiz., 46: 1138-9(Mar. 1964). (In Russian)

Previously the half life of ^{157}Tb was given as greater than 100 years. Tantalum was exposed to 660-Mev protons to produce ^{157}Dy of which ^{157}Tb is the daughter. From this target a preparation of ^{157}Tb was made by fourfold chromatographic cleaning, containing a total of $(4.0 \pm 1.3) \times 10^{12}$ ^{157}Tb nuclei. The absolute activity was observed for four months with the result that dN/dt was found to be $(1.9 \pm 0.2) \times 10^4$ decays per minute. Finally the half life was determined as: $T_{1/2} = (2.8 \pm 1.2) \times 10^2$ years. Published Japanese work showed a half life of 160 ± 40 years, which is within the limits of error of the value found. The calculation of lg ft as 7.4 ± 0.2 was somewhat higher than for other cases in which the transition is between states $3/2^+$ [411] and $3/2^-$ [521]. (TTT)

24697 ANGULAR AND ENERGY CHARACTERISTICS OF THE FISSION-NEUTRON EMISSION OF URANIUM-235. M. V. Blinov, N. M. Kazarinov, and A. N. Protopopov. Zh. Eksperim. i Teor. Fiz., 46: 1129-41(Mar. 1964). (In Russian)

The energy spectrum of neutrons emitted at the time of the thermal-neutron-induced fission of ^{235}U was determined in a center-of-mass system. The results obtained were used to calculate the angular and energy spectra and these were compared with experimental data. The velocities of a fragment and of the neutrons emitted by it under an angle of 15° were measured simultaneously, using the time-of-flight method. From these data, the velocity of the neutron was calculated and the neutron emission spectrum (ϵ = 1.28 Mev) was obtained. The emission spectra of neutrons from light and heavy fission fragments were found to be identical within the experimental error. The intensities and the energies of neutrons escaping under various angles with respect to the direction of the fragments were also measured and both the total distribution and that of the light fragments were determined. The data indicated that a systematic softening of the spectra takes place as the angle is increased from 0 to 90° while the intensity decreases at the same time. It was concluded that about 90% of the neutrons are emitted by the usual cascade neutron evaporation from fully accelerated fragment nuclei. (TTT)

24698 CROSS SECTION FOR PHOTOPROTON EMISSION FROM COPPER. B. S. Ratner (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 46: 1157-62(Apr. 1964). (In Russian)

The cross section for photoproton emission from copper is measured from the threshold to $E_\gamma = 27$ Mev by directly recording the protons with CsI(Tl) crystals. In contrast to the cross sections measured for other nuclei, the energy dependence of the cross section has a complex shape with maxima at $E_\gamma = 12.5 \pm 0.5$, 16.5 ± 0.5, and 20.5 ± 0.5 Mev. It is suggested that the first two maxima are due to dipole absorption of the quanta by a single proton in the $2p_{3/2}$ state in excess of the filled shell $1f_{7/2}$ corresponding to a magic nucleus with Z = 28. (auth)

24699 γ-RAYS FROM RADIATIVE CAPTURE OF FAST NEUTRONS IN MANGANESE AND COPPER. A. T. Bakov and Yu. A. Kazanskii. Zh. Eksperim. i Teor. Fiz., 46: 1163-8(Apr. 1964). (In Russian)

The spectra of γ rays emitted in radiative capture of thermal and fast neutrons are measured with a single-crystal scintillation γ spectrometer. The probability of emission of 8-Mev γ quanta is from 4 to 5 times smaller for fast neutron capture in copper than for thermal neutrons. The γ-ray spectrum in manganese is practically undeformed. (auth)

24700 INVESTIGATION OF THE TIME CORRELATION OF PHOTONS EMITTED IN THE NeII SPECTRAL LINES OF SEPARATE NEON ATOMS EXCITED BY ELECTRON IMPACT. Yu. F. Skachkov. Zh. Eksperim. i Teor. Fiz., 46: 1188-96(Apr. 1964). (In Russian)

It is shown that neon atoms excited by electron impact simultaneously emit on the average 2 ± 0.2 photons in the ~3000–4000 Å spectral range in the NeII lines. A calculation based on the intensity of the spectral lines in the

NeII cascade transitions shows that on the average an atom can simultaneously emit no more than 1.6–1.7 photons. (auth)

24701 ON THE NUMBER OF NEUTRONS EMITTED BY U^{235} FISSION FRAGMENTS. V. F. Apalin, Yu. N. Gritsyuk, I. E. Kutikov, V. I. Lebedev, and L. A. Mikaelian. Zh. Eksperim. i Teor. Fiz., 46: 1197-1204(Apr. 1964). (In Russian)

The number of neutrons ν emitted by the fragments of ^{235}U fission induced by thermal neutrons are measured with an ionization chamber and a cadmium neutron detector. The data obtained contradict the hypothesis of a universal dependence of ν on the fragment mass. Calculations show that in the vicinity of symmetrical fission the fragment excitation energy increases by ~20 Mev. (auth)

24702 IONIZATION ENERGY LOSSES BY FAST ELECTRONS IN THIN POLYSTERENE LAYERS. A. I. Alikhanyan, A. K. Valter, G. M. Garibyan, I. A. Grishaev, M. P. Lorikyan, V. V. Petrenko, and G. D. Fursov (Inst. of Physics, Yerevan, SSR and Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 46: 1212-15(Apr. 1964). (In Russian)

The dependence of the ionization energy losses of electrons on their momentum is investigated experimentally. It is shown that for film thicknesses up to 2×10^{-5}cm the ionization losses logarithmically increase with the momentum. (auth)

24703 DEFORMATION COOLING. U. Kh. Kopvillem and V. R. Nagibarov (Inst. of Physics and Tech., Kazan). Zh. Eksperim. i Teor. Fiz., 46: 1360-2(Apr. 1964). (In Russian)

A formula is derived that describes the temperature change in a system as a result of adiabatic removal of an external force. As an example cooling of a spin system in the ground and excited states due to removal of elastic stresses is considered. The possibility of employing deformation cooling for polarization of electron and nuclear spins is discussed. (auth)

24704 DOUBLE BREMSSTRAHLUNG IN THE CASE OF ALMOST COLLINEAR MOMENTA. L. G. Zazunov and P. I. Fomin (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 46: 1392-4(Apr. 1964). (In Russian)

The double bremsstrahlung cross section is calculated in the case when the energies of photon beams are not small and the mutual momenta directions are almost collinear. In the region of sufficiently small deviations from collinearity double bremsstrahlung exceeds single photon bremsstrahlung. With an appropriate substitution of the momenta the formulas obtained also describe a number of other processes possessing similar Feynman diagrams. (auth)

24705 AN ANALYSIS OF PHOTODISINTEGRATION OF H^3 BY TAKING INTO ACCOUNT THE RIGID CORE OF THE NUCLEON. V. N. Fetisov (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 46: 1395-8 (Apr. 1964). (In Russian)

Photodisintegration of ^3H is performed with aid of the wave functions derived by Kikuta, Morita, and Yamada. The dependence of the integral cross section σ_{-1} on the radius of the rigid core of the nucleon is presented. The cross section for the $^3H(\gamma,d)n$ reaction calculated with the KMY wave function is close to that obtained by Gunn and Irving if the functions for the ground state of ^3H yield similar mean square radii. The cross section in the vicinity of the maximum does not exceed the experimental value by more than one and a half times. (auth)

24706 NUCLEAR ORIENTATION. M. E. Rose, ed. International Science Review Series. Volume VI. New York, Gordon and Breach Science Publishers, 1963. 334p. $4.95.

Static and dynamic methods of producing an ensemble of nuclei whose spin directions are not uniformly distributed over the usually degenerate substates belonging to a given angular momentum, are discussed. Approximately 48 reprints are presented. (R.E.U.)

24707 PROCEEDINGS OF THE THIRD CONFERENCE ON REACTIONS BETWEEN COMPLEX NUCLEI, HELD AT ASILOMAR (PACIFIC GROVE, CALIFORNIA) APRIL 14-18, 1963. A. Ghiorso, R. M. Diamond, and H. E. Conzett, eds. Berkeley and Los Angeles, University of California Press, 1963. 463p. (CONF-62). $17.00.

Scattering, direct reactions, compound systems, Coulomb excitation, and spectroscopy are discussed for heavy ions. Separate abstracts are prepared for 31 of 68 papers presented. Abstracts of the remaining papers previously appeared in NSA (17: 20989, 20990, 20991, 20992, 22550, 22558, 24391, 25868, 26468, 26469, 26470, 26554, 27949, 28251, 28252, 28253, 28255, 28256, 28257, 28258, 28259, 28343, 31396, 31399, 31400, 31542, 32999, 33087, 33088, 33094, 33098, 34982, 36649, 36650, 38080, 18: 1039 and 13058). (C.E.S.)

For abstracts of individual papers see: 24325, 24708, 24709, 24710, 24711, 24712, 24713, 24714, 24715, 24716, 24717, 24718, 24719, 24720, 24721, 24722, 24723, 24724, 24725, 24726, 24727, 24728, 24729, 24730, 24731, 24732, 24733, 24734, 24735, 24736, and 24737.

24708 THE INELASTIC SCATTERING OF C^{12} AND O^{16} BY Pb^{208}. K. H. Wang and J. A. McIntyre (Yale Univ., New Haven). p.31-5 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

The elastic scattering of complex nuclei was shown to be describable in semiclassical terms when the Coulomb parameter, $\eta = ZZ'e^2/\hbar v$, is significantly larger than 5 and to be describable in terms of the diffraction of waves when η is significantly less than 5. With one exception, the inelastic scattering experiments thus far performed have corresponded to η-values less than 5 and have shown the characteristic diffraction structure. In the experiments reported for ^{12}C scattered by ^{208}Pb, $\eta = 25.2$ and the angular distribution of the inelastically scattered ^{12}C nuclei shows a semiclassical behavior, the maximum cross section being obtained at an angle corresponding to a ^{12}C trajectory grazing the ^{208}Pb nucleus. Inelastic scattering is observed for excitation of the ^{208}Pb nucleus to its 2.6-Mev level. A 4.4-Mev excitation is also observed which may be associated either with the 4.3-Mev level in ^{208}Pb or the 4.4-Mev level in ^{12}C. It is interesting that the excitation of ^{208}Pb by electron scattering shows the excitation of the 2.6- and 4.3-Mev levels. Inelastic scattering of 166-Mev ^{16}O ions to these two levels was investigated but not observed. (auth)

24709 THE SCATTERING OF 168 Mev O^{16} NUCLEI FROM C^{12}. Gerald T. Garvey and John C. Hiebert (Yale Univ., New Haven). p.36-44 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

An ^{16}O beam was scattered from thin ^{12}C targets. Angular distributions for center-of-mass angles 15 to 45° were obtained for the elastic scattering and the inelastic scattering involving the excitation of the 2+, 4.43-Mev state in ^{12}C and the 3-, 6.14-Mev state in ^{16}O. These distributions show a diffraction-like behavior and agree well with the phase rule of J. S. Blair. The excitations are the strongest inelastic processes observed over the range of angles studied. There is evidence for smaller groups corresponding to Q-values of -7.0 ± 0.5, -14.0 ± 1.0 Mev, and a group at -10.3 ± 0.5 Mev that is shown to result principally from the mutual excitation of the 4.43- and 6.14-Mev states in ^{12}C and ^{16}O respectively. An angular distribution for this process is presented. The magnitudes of the cross sections of the first 2+ states in ^{12}C and ^{16}O differ by a factor of at least 5 as do the magnitudes for the excitation of the first 3- states. Available (A,A') inelastic scattering data on ^{12}C and ^{16}O with similar momentum transfer are compared to the present data. (auth)

24710 ELASTIC AND INELASTIC SCATTERING OF CARBON FROM CARBON. R. H. Bassel, G. R. Satchler, and R. M. Drisko (Oak Ridge National Lab., Tenn.). p.45-9 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

The measurements of Wang et al. and Gravey et al. on the scattering of 127-Mev carbon ions from carbon show, in addition to elastic scattering, strong single-excitation of the 4.43-Mev (2+) state in one of the nuclei, the single-excitation of the 14-Mev (4+) state, and the mutual excitation of both nuclei to the first excited state. On the assumption that the two-body effects are predominant, the data were analyzed for the single excitations in terms of the collective model in distorted wave approximation and in strong coupling approximation where the rotational model is assumed. Good agreement was found between theory and experiment, both in absolute magnitude and in shape of the angular distributions. (auth)

24711 NUCLEAR SCATTERING AND TWO-NUCLEON FORCES. E. Schmid (Florida State Univ., Tallahassee), K. Wildermuth, and Y. C. Tang. p.59-60 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

The integro-differential equation for the elastic scattering of ^{3}He by α-particles is derived using a two-body force which is consistent with the low and medium energy nucleon nucleon scattering data. Cross sections and phase shifts calculated over the energy range from 1-50 Mev are in good agreement with the available experimental data. From the calculated wave function one can derive the local optical potential that generates the same wave function. This potential is energy and angular momentum dependent and is rather singular in the surface region. By generalization of the example one can conclude that this rather singular behavior of the optical potential in the surface region is characteristic for any optical potential scattering. This has sometimes important consequences for optical model calculations and especially distorted wave calculations. The above example allows also the study of exchange- and transfer-reactions. (auth)

24712 COMPLEX NUCLEUS ASPECTS OF ALPHA-PARTICLE SCATTERING. R. H. Davis (Florida State Univ., Tallahassee). p.61-8 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

Alpha particles were scattered from ^{12}C, ^{16}O, and ^{28}Si in the bombarding energy range 6 to 19 Mev. Phase shift, optical model, and smooth cutoff model analyses were applied to the data obtained in these experiments. Optical model analysis yields values for the real well depth of approximately 100 Mev which is qualitatively consistent with the optical model potentials for the constituent nucleons in the alpha-particle projectile. The smooth cutoff model is consistent with a short alpha-particle mean free path in nuclear matter and was successfully used to fit elastic scattering data when resonant phase shifts were added. Several bands of states in the compound systems ^{16}O and ^{20}Ne were observed with rotational state energy systematics. Rotational states with large alpha-particle widths are interpreted as alpha-particle clusters rotating outside the target nucleus core. The width of alpha-particle rotational states may be estimated from the rotational energy parameter, and the calculated values are in satisfactory agreement with observed widths. (auth)

24713 SIMPLE INTERFERENCE CONCEPTS IN SCATTERING AND STRIPPING. D. R. Inglis (Argonne National Lab., Ill.). p.81-4 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

Particularly because semiclassical methods are useful in heavy-ion reactions, the understanding in pictorial terms of scattering and normal stripping events is of interest. The simplest example is the Blair phase rule relating the angular positions of the maxima of elastic and inelastic scattering of alphas, or of certain heavy ions. The basic model is the comparison of Fraunhofer diffraction from a disk and a ring, and it may be modified by Coulomb and finite-range effects. The diffraction-like patterns of stripping reactions are related to this. (auth)

24714 PICKUP OF HEAVY CLUSTERS. R. M. Drisko, G. R. Satchler, and R. H. Bassel (Oak Ridge National Lab., Tenn.). p.85-9 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

It was suggested that the existence of alpha-particle clusters in nuclei might be determined by a study of the (d,^{6}Li) reaction, or its inverse. Accordingly, Denes and Daehnick have measured angular distributions of ^{6}Li ions produced by deuteron bombardment of ^{12}C, ^{16}O, ^{18}O, and ^{19}F. These experiments also revealed formation of ^{7}Li ions with cross sections comparable to those for the production of ^{6}Li. The angular distributions show forward peaking, suggesting a pickup process. This data was analyzed in distorted wave approximation; an extreme cluster model was assumed for the heavy cluster and the residual nucleus. Reasonable agreement between experimental and theoretical angular distributions was found. The magnitudes of the calculated cross sections are discussed. (auth)

24715 BORON-INDUCED TRANSFER REACTION STUDIES. M. Sachs, C. Chasman, and D. A. Bromley (Yale Univ., New Haven). p.90-6 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

The deuteron transfer reaction ^{12}C(^{11}B,^{9}Be)^{14}N was studied using 115.5-Mev ^{11}B ions. By means of instrumentation described elsewhere, ^{9}Be energy spectra were obtained at a number of angles. These disclose strong selective population of isolated states or small groups of states in the residual nuclei. Since ^{9}Be is particle-unstable in all its excited states, all structure in the ^{9}Be spectrum corresponds to excitations in ^{14}N. The strongest ^{9}Be group corresponds to about 9 Mev of excitation in ^{14}N; the next, to about 13 Mev. Weaker population of other low-lying levels is also observed. In the center-of-mass angle range 15.5-59°, the differential cross sections for the groups to the 9- and 13-Mev states show an exponential decrease with increasing angle, both increasing by a factor of 2 every 7.5°. At 15.5° the values for the differential cross sections are respectively 3.6 and 2.0 mb/steradian. The corresponding total cross sections are estimated to be 0.8 and 0.4 mb. The relevance of these data to a cluster interpretation of these nuclei is discussed. The proton transfer reaction $^{12}C(^{11}B,^{10}Be)^{13}N$ was studied simultaneously, and data on this reaction is presented, again showing selective population of isolated states. (auth)

24716 SINGLE-NUCLEON TRANSFER EXCITATION FUNCTIONS. K. S. Toth and E. Newman (Oak Ridge National Lab., Tenn.). p.114-19 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California, Press, 1963.

Thick targets of Sc_2O_3, KI, RbCl, ZnS, P, Al, and ZnO were bombarded with 27.5-Mev ^{14}N ions and excitation functions were obtained for the single-nucleon transfer reactions $^{45}Sc(^{14}N,^{15}N)^{44}Sc$; $^{45}Sc(^{14}N,^{15}N)^{44m}Sc$; $^{39}K(^{14}N,^{15}O)^{38}Ar$; $^{35}Cl(^{14}N,^{15}O)^{34}S$; $^{35}Cl(^{14}N,^{15}N)^{34m}Cl$; $^{32}S(^{14}N,^{15}O)^{31}P$; $^{31}P(^{14}N,^{13}N)^{32}P$; $^{27}Al(^{14}N,^{15}O)^{26}Mg$; and $^{16}O(^{14}N,^{15}O)^{15}N$. Transfer reactions resulting in ^{15}O were identified by the annihilation radiation due to the ^{15}O positrons. The remaining four reactions were identified by the characteristic half lives and γ radiations of the following nuclei ^{44}Sc, ^{44m}Sc, ^{34m}Cl, and ^{32}P. The cross sections at 27.0 Mev were found to be 0.30, 0.25, 0.35, 1.35, 0.73, 1.55, 1.90, 0.45, and 0.65 mb for the reactions in the order listed. Single-nucleon transfer excitation functions at low bombarding energies were examined from the standpoint of the tunneling theory. It was found that reactions involving the targets ^{10}B and ^{14}N invariably behave anomalously. Explanations of this behavior are offered. The ratios of reduced widths for the transferring neutron in ^{14}N and ^{19}F were determined from four pairs of reactions. These four ratios, which should be identical, agree to within a factor of three. The universal curve noted earlier for transfer reactions were found to be invalid when all the available data are considered. (auth)

24717 A STUDY OF MULTINUCLEON STRIPPING REACTIONS IN BOMBARDMENT OF Ta WITH Ne^{20} IONS. W. Grochulski, T. Kwiecinska, Go-chan Lian, E. Lozynski, J. Maly, L. K. Tarasov, and V. V. Volkov (Joint Inst. for Nuclear Research, Krakow). p.120-8 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

A study of multinucleon stripping reactions on Ta was made. The target of Ta was bombarded with 160-Mev ^{20}Ne ions. To separate the reaction products in the rare region the ion-exchange chromatographic method was used. Identification of originated isotopes was done by methods of γ spectroscopy. Stripping of about twenty nucleons was observed. When only the protons were stripped a sharp decrease of the cross section took place. The obtained results seem to indicate that the correlated groups of nucleons are transferred to the beam nuclei. An attempt was made to connect the reaction Q-value with the observed cross section. (auth)

24718 ANGULAR DISTRIBUTION OF N^{15} PARTICLES FROM THE TRANSFER REACTION $Al^{27}(O^{16},N^{15})Si^{28}$. E. Newman, K. S. Toth, and A. Zucker (Oak Ridge National Lab., Tenn.). p.143-7 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

The angular distribution of ^{15}N particles, resulting from the transfer reaction $^{27}Al(^{16}O,^{15}N)^{28}Si$, was determined. A thin aluminum target was bombarded with 30-Mev ^{16}O ions. Two Si surface barrier counters, placed at the proper angles, were used to detect the ^{15}N and ^{28}Si particles in coincidence. A proportional counter imposed the further restriction that particles observed in the defining counter be nitrogen nuclei. Angular distributions were determined for two particular transfers: the first leaving both residual nuclei in their ground states, and the second leaving the ^{28}Si in its first excited state. Within experimental error the two distributions peak at the same center-of-mass angle, ~78°. By integrating the differential cross sections, the total reaction cross sections were determined to be 1.3 mb for the ground-state transfers and 1.6 mb for the excited-state reaction. The following radius parameters, r_0, were deduced: 1.81 ± 0.04 and 1.73 ± 0.04 F for the ground- and excited-state distributions, respectively. The angular distributions were compared to the predictions of the tunneling theory of Breit bearing in mind that the theory, as formulated, is applicable to the transfer of neutrons and not protons. The agreement, however, was found to be good for the excited-state distribution and fair for the ground-state distribution. The investigation is being extended to other ^{16}O energies. (auth)

24719 DISTORTED WAVE ANALYSIS OF NUCLEAR TRANSFER REACTIONS. Tetsuo Kammuri (Osaka Univ.) and Ryuzo Nakasima. p.163-7 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

Nucleon transfer reactions between complex nuclei are investigated by the method of the distorted wave Born approximation. The distorting potential is assumed to be the usual Coulomb potential plus an optical potential. When the wave functions for relative motion are expanded in partial waves, centrifugal repulsion makes the effect of large angular momenta negligible. Low angular momenta do not contribute to the process because of strongly absorptive nuclear interaction. Then the transition amplitude becomes an average of Legendre functions with suitable phase factors, over a small interval of values of angular momentum that corresponds to grazing contact of both nuclei. When the Q-value of the reaction is set equal to zero, the previous semiclassical formula for the cross section of multinucleon transfer is derived. Connection with classical elastic scattering is discussed. (auth)

24720 NUCLEAR REACTION STUDIES WITH LITHIUM IONS ON B^{10} AND B^{11} TARGETS. G. C. Morrison, N. H. Gale, M. Hussain, and G. Murray (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.168-77 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

Angular distributions of the charged particles emitted from lithium-induced reactions on ^{10}B and ^{11}B targets leading to discrete states in the final nuclei are being studied for incident energies in the range 3.5 to 4.5 Mev. This combination of targets and projectiles permits the study of different reactions leading to the same final nucleus, as for example $^{10}B(^6Li,p)^{15}N$, $^{10}B(^7Li,d)^{15}N$, $^{11}B(^6Li,d)^{15}N$, and $^{11}B(^7Li,t)^{15}N$. Identification of the outgoing particles is based on the measurement of ΔE in a small gas-flow proportional counter or thin, 0.001-0.002 in. solid state detector and E in a thick solid state detector of high resistivity. The particle selection is achieved by using a fast computer that performs the multiplication of ΔE and E and provides an output pulse proportional to the particle mass. The shape of the observed angular distributions are in general asymmetric about 90° and show little change with bombarding energy. It appears therefore that the reactions proceed mainly by a direct interaction process. From a comparison of the angular distributions of the reaction products leading to the same states in the final nucleus, information was obtained on the reaction mechanisms of importance. (auth)

24721 GAMMA-RAY STUDIES OF B^{11}, N^{14}, AND F^{19} INDUCED TRANSFER REACTIONS. G. Hortig, H. Werner, and W. Gentner (Max-Planck-Institut fur Kernphysik, Heidelberg). p.178-80 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

Gamma-ray spectra were observed from the reactions induced below the Coulomb barrier by ^{11}B, ^{14}N, and ^{19}F ion beams in various targets of light elements. Some of these spectra show prominent gamma rays of 3–9 Mev which are related to de-excitation gamma rays from nuclei left in an excited state after being formed by nucleon transfer. (auth)

24722 TWO-PARAMETER ANALYSIS OF LITHIUM REACTIONS. R. R. Carlson and E. Norbeck (Iowa State Univ., Ames). p.181-5 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

A 256 × 256 channel two-parameter analyzer made up of a general purpose computer and two 256-channel pulse-height analyzers was used to study particle-gamma coincidence spectra, particle-particle coincidence spectra, and to identify particle mass by simultaneous measurement of energy and energy-loss rate. Reactions were induced by 3-Mev lithium ions bombarding lithium, beryllium, and boron. These reactions produce such a richness of results that a 65,536-channel analyzer is a necessity. A particle-gamma coincidence study gave the uncontaminated gamma decay of all of the bound levels of the ^{11}B, ^{12}B, and ^{13}B isotopes in one experiment. A particle-particle coincidence study for the $^6Li + {}^6Li$ reaction showed that most, although not all, of the three-body products are made directly in this case. Three-body breakup accounts for most of the cross section for lithium-induced reactions on the light isotopes studied. This was shown by the particle identification system which separated masses from one to six from neighbors. In almost every case a large continuum sets in at the energetic threshold for multibody disintegration. (auth)

24723 DISSOCIATION REACTIONS IN LIGHT NUCLEI. R. Ollerhead, C. Chasman, and D. A. Bromley (Yale Univ., New Haven). p.191-8 of "Proceedings of the Third Conference on Reactions Between Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

Direct dissociation of light nuclei in interactions with targets of different atomic number was investigated. Each product spectrum exhibits a broad peak, centered at an energy corresponding to the beam velocity, whose position and shape are consistent with classical kinematic calculations assuming dissociation of the projectile in a direct interaction with the target nucleus. Measurements were made on the binary dissociation of ^6Li, ^7Li, ^{10}B, and ^{11}B, utilizing carbon and nickel targets; in each case, an alpha-particle was one of the two dissociation products. The observed differential and total cross section data are considered within the framework of current nuclear cluster models in order to provide information on the details of the reaction mechanism and nuclear characteristics involved. (auth)

24724 THE $C^{12}(C^{12},\alpha)Ne^{20}$ REACTION. J. Borggreen, B. Elbek, R. B. Leachmann, M. C. Olesen, and N. O. R. Poulsen (Universitet, Copenhagen). p.201-6 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

The reaction $^{12}C(^{12}C,\alpha)^{20}Ne$ was investigated at energies from 9 to 15.6 Mev. The α groups from a 40/μg/cm² C target were detected in a solid-state counter from which the individual groups feeding the five lowest states in ^{20}Ne could be resolved. The yield curves for these five groups show strong fluctuations having the character of resonances approximately 150 kev wide. In the energy region where the measurements overlap, the yield of the ground-state alphas is very similar to that of ^{12}C ions from the inverse reaction observed by Lassen. The angular distribution of the various alpha groups is generally quite complicated showing components of Legendre polynomials of high order. One dominant order of squared Legendre polynomial is evident in the angular distribution of ground-state alphas at three of the resonances; in two cases the order is eight, in one case ten. In other cases apparently clean resonances in the 90° yield do not show any simple angular distribution. For the excited states the angular distribution of the α groups rarely shows null-points and cannot be fitted with polynomials characteristic of transitions involving a single angular momentum. (auth)

24725 A SPONTANEOUSLY FISSIONING ISOMER PRODUCED IN REACTIONS WITH CHARGED PARTICLES. G. N. Flerov, S. M. Polikanov, V. L. Mikheev, V. P. Perelygin, and A. A. Pleve (Joint Inst. for Nuclear Research, Dubna, USSR). p.219-22 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

A spontaneously fissioning isomer with a 0.014 ± 0.002 sec half life was produced in ^{20}Ne, ^{22}Ne, ^{16}O, ^{11}B, and ^{10}B reactions with ^{238}U and alpha particle reactions with ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{243}Am, and ^{241}Am. Experimental data indicate an isomeric state of ^{242}Am whose spontaneous fission probability is greatly increased. (C.E.S.)

24726 ANGULAR-MOMENTUM EFFECTS IN COMPOUND-NUCLEUS REACTIONS. M. L. Halbert and F. E. Durham (Oak Ridge National Lab., Tenn.). p.223-31 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

The decay of a compound nucleus will not be independent of its mode of formation if angular momentum is limited for some exit channels. Furthermore, the angular distribution of emitted particles will not be isotropic, though 90° symmetry will be retained. These effects were demonstrated in reactions of 27-Mev ^{14}N ions with ^{12}C, ^{16}O, ^{23}Na, and ^{27}Al targets. Energy distributions of alpha particles were measured at angles from 0 to 165°. The apparent level densities, determined from these spectra through the usual division by channel energy and inverse cross section, were fitted with the simplified Fermi-gas expression

$\rho(E^*) \sim \exp 2\sqrt{a(E^* - b)}$. The best fit for the parameter a changes with angle. This indicates that the independence hypothesis is incorrect. The average values of these parameters are a = 1.3, 3.5, 3.6 Mev^{-1} and b = −1, 0, 0 Mev for the residual nuclei ^{26}Al, ^{33}S, ^{37}Ar, respectively. For any given channel energy, the experimental angular distributions are symmetric about 90° and are strongly peaked forward and backward. The spin cutoff parameter σ in the level density $\rho(E^*,j) \sim \rho(E^*)\ (2j + 1) \exp[-j(j + 1)/2\sigma^2]$ was calculated according to the semiclassical theory of Ericson and Strutinsky. For the reactions with ^{16}O, $\sigma = 2.8 \pm 0.4$ provides satisfactory fits from 4 to 12 Mev excitation in the residual ^{26}Al. For ^{23}Na reactions, $\sigma = 3.0 \pm 0.6$ fits the data from 6 to 18 Mev excitation in ^{33}S. These results are insensitive to the parameters describing the energy variation of $\rho(E^*)$. (auth)

24727 PRECISION MEASUREMENTS OF EXCITATION FUNCTIONS FOR THE COULOMB EXCITATION OF THE 2+ AND 4+ ROTATIONAL LEVELS IN Sm^{152}. G. Goldring, J. de Boer, and H. Winkler (California Inst. of Tech., Pasadena). p.278-84 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

The excitation functions for the 2+ → 0+ and 4+ → 2+ gamma transitions in ^{152}Sm were measured by bombarding a thin ^{152}Sm target with oxygen ions of energies between 18 and 42 Mev and observing gamma rays in coincidence with backscattered ions detected in an annular junction counter. The ratio of coincidence counts to the number of counts in the junction counter gives directly the quantities: $1 - P_0$ for the 2+ → 0+ transition and $1 - P_0 - P_1$ for the 4+ → 2+ transition, where $P_0, P_1, \ldots\ldots$ are the probabilities for elastic scattering, for excitation of the 2+ state, etc. in a scattering event. $1 - P_0 = P_1 + P_2 + \ldots$; $1 - P_0 - P_1 = P_2 + P_3 + \ldots$. Measurements of P_1 were carried out in this way to a relative accuracy of about one per cent over the range of bombarding energies indicated above in which P_1 changes by about a factor of twenty. P_2 was determined to about three per cent. Such a degree of precision is significant since the ratio of second-order to first-order processes (such as P_2/P_1) varies in this range from a very small value to about ten per cent, so that these measurements can be considered as measurements of the second-order terms in P_1 and in particular of the static quadrupole moment of the 2+ state, the only unknown nuclear quantity involved in this case. Experimental conditions and factors involved in such precision measurements are discussed. In particular the geometry of the gamma counter is described. This was set up in a way which ensures the identical vanishing of both $P_2(\cos\theta)$ and $P_4(\cos\theta)$ terms—the only terms involved in pure E2 processes—and therefore makes it possible to avoid considerations of angular distributions in these highly anisotropic processes. (auth)

24728 MULTIPLE COULOMB EXCITATION IN DEFORMED NUCLEI. Hans Luetken and Aage Winther (Universitet, Copenhagen). p.285-8 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

By multiple Coulomb excitations in deformed nuclei one may observe also a weaker excitation of rotational bands that are associated with states of different intrinsic structure. The excitation amplitudes of such states were computed in the approximation where one neglects the energy difference between the states within rotational bands. The results are given for the case of dipole, quadrupole, and octupole excitations in the form of tables. The results show that the relative population of the states within a band depends strongly on the spin and K quantum numbers as well as on admixtures in the wave function of components from the ground-state band. A detailed investigation of the dependence of the cross sections on scattering angle is presented. One finds appreciable deviations from the so-called $\chi(\vartheta)$-approximation, especially concerning the excitation of the unnatural parity states. (auth)

24729 COULOMB EXCITATION OF VIBRATIONAL STATES IN DEFORMED NUCLEI. Y. Yoshizawa, B. Elbek, B. Herskind, and M. C. Olesen (Universitet, Copenhagen). p.289-94 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

Oxygen ions at energies from 38 to 48 Mev were used for Coulomb excitation studies of low-lying states in rare-earth isotopes. Gamma rays from thin (~0.3 mg/cm^2) oxide targets sprayed onto Ni foils (0.25 mg/cm^2) were recorded in coincidence with backscattered ions. The yields were normalized to the elastic group from the Rutherford scattering. A double group of gamma rays ascribed to the $2'+ \to 0+$ and the $2'+ \to 2+$ transitions from a gamma-vibrational state were observed in ^{150}Nd(1.06 Mev), ^{152}Sm, ^{154}Gd, ^{156}Gd, ^{160}Gd(1.01 Mev), ^{160}Dy, ^{162}Dy(0.89 Mev), ^{164}Dy(0.77 Mev), ^{164}Er(0.86 Mev), ^{166}Er, ^{168}Er, and ^{170}Er(0.93 Mev) where the $2'+$ energy is given for states not observed before. Transitions from the $2'+$ and $0'+$ states in the beta-vibrational band were observed in ^{150}Nd(0.69 Mev), ^{152}Sm, ^{154}Gd(0.68 Mev), and ^{156}Gd(1.04 Mev) where the energies are to be the $0'+$ state. The B(E2)-values determined from the yields are typically of the order of 4 single-particle units. (auth)

24730 HIGHER ORDER PERTURBATIONS IN NUCLEAR COLLECTIVE MOTION. J. S. Greenberg, D. A. Bromley, G. C. Seaman, and E. V. Bishop (Yale Univ., New Haven). p.295-302 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

Systematic deviations from simple rotational model predictions were investigated in a number of rare-earth nuclei using multiple Coulomb excitation induced by ^{16}O ions to extend significantly the existing information on the ground-state and higher lying bands. For example, measurements obtained on ten states of the ^{159}Tb ground-state band are characterized by alternating positive and negative deviations in the level excitations from predictions based on only first- and second-order terms in I(I + 1). A number of possible perturbation mechanisms were considered. These include Coriolis mixing with higher-lying $K = \frac{1}{2}$ bands for which some slight evidence exists, and effects due to symmetrization in the $K = \frac{3}{2}$ ground-state band (i.e., a $K = \frac{3}{2}$ decoupling effect). A number of collective excitations were observed in ^{152}Sm which can be assigned to the excitation of 4 members of the ground-state band, 3 members of the gamma-vibrational band, and 4 members of the beta-vibrational band. The relative transition probabilities for de-excitation of the states in beta and gamma bands were measured and used to analyze the effect of the interband mixing on the energy level spacings in the ground-state band. (auth)

24731 SYMMETRIZATION IN COULOMB EXCITATION CALCULATIONS. P. J. Brussaard and L. C. Biedenharn (Duke Univ., Durham, N. C.). p.311-16 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

The analysis of Coulomb excitation experiments generally involves the use of some semiclassical approximation, i.e., the particle orbits are treated classically, and the nuclear transition quantum mechanically. Although a complete quantum treatment is straightforward, as a practical matter the desired results are not available in sufficient detail, particularly for the angular distribution of the inelastically scattered particles. The classical orbit treatment fails to distinguish the initial and final particle parameters (k_i, k_f; η_i, η_f). A significant improvement in accuracy results from requiring that the semiclassical approximation satisfy the reciprocity requirement. This requirement does not imply a unique result, and it is not generally recognized that the semiclassical formulas, as given and employed in the literature are still to a large extent ad hoc. This problem is re-examined and it is demonstrated that the correspondence principle leads to the unique prescription that $v_{\text{classical}} \rightarrow [v_i v_f(v_i + v_f)/2]^{1/3}$, and not the geometric mean. This prescription, and an extension of the Kramers approximation ($l \rightarrow l + 1/2$) to the Sommerfeld number η, will be applied to the E2 inelastic angular distribution as an illustration. The error in the usual semiclassical result is ~40%; the use of the above symmetrization reduces this to ~10%. (auth)

24732 INTERACTION MECHANISMS OF 200-Mev Ne^{20} WITH Ag AND Br NUCLEI. R. Pfohl, Ch. Winter-Gegauff, and J. P. Lonchamp (Center for Nuclear Studies, Strasbourg). p.360-5 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

Nuclear reactions were studied in nuclear plates irradiated with 200-Mev ^{20}Ne. The cross sections for the production of 3- to 6-pronged stars are given. Evidence is given for a grazing-contact mechanism: Heavy fragments, plus α-particles or protons, produced in the reaction with approximately the velocity of the incident Ne, are strongly peaked forward. The charges of these heavy fragments—measured by the photographic method—are less than the charge of the projectile. For the other stars the p angular distributions are isotropic to the c.m. system. The α angular distributions are isotropic at backward angles but peaked forward. The energy spectra for various incident energies are broad for the α's, with a high-energy tail. These high-energy α's are strongly forward peaked. A lowering of the Coulomb barrier is assumed. The ratio forward to backward, F/B, increases with the incident energy, from 2.5 to 4.2 for the α's, and from 0.8 to 1.3 for the p's. The ratio (number of α's)/(number of p's) is about 0.7 in the interval 90 to 180° and 2.3 in the interval 0 to 90°. In conclusion, an evaporation-like mechanism operates in the backward hemisphere, whereas in the forward hemisphere there is a competition between evaporation and direct interaction processes. (auth)

24733 STATES OF THE COMPOUND NUCLEUS WITH HIGH ANGULAR MOMENTUM. Daniel Sperber (Armour Research Foundation, Chicago). p.379-86 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

Recently the states of the compound nucleus with high angular momentum were observed by bombarding target nuclei with heavy ions. It was shown that this high angular momentum of the compound nucleus affects the fission barrier and various angular distributions. Also, the level density depends on angular momentum. In previous calculations of equilibrium shapes and fission barriers, spherical or spheroidal shapes were assumed. An analytic method is used to obtain exact explicit formulas for the equilibrium or rotating liquid drop chargeless nuclei for the entire range of angular momenta for which stable equilibrium exists without resorting to the limitation of spheroidal shapes or small rotational energy. The stability of the forms is investigated and the fission barrier calculated. For comparison the effective moment of inertia of nuclear states with high angular momentum is calculated assuming that all observable quantities are due to sums of contributions from single particles. All calculations indicate a moment of inertia of the order of magnitude of that of a rigid body. (auth)

24734 RECOIL RANGE STRAGGLING OF HEAVY ION REACTION PRODUCTS IN HELIUM. Jacob Gilat and John M. Alexander (Univ. of California, Berkeley). p.387-8 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

The advantages of using a gaseous rather than solid stopping medium for the study of recoil properties of nuclear reaction products are discussed. Results of range and range straggling measurements of ^{149}Dy recoils from the $^{144}Nd(^{12}C,7n)^{149}Dy$ reaction in helium are presented. With 108-Mev ^{12}C ions, the range straggling parameter is 0.160 ± 0.005, as compared to 0.240 obtained in Al foils, under similar conditions. (auth)

24735 DETERMINATION OF SOME FRAGMENT YIELDS FROM FISSION OF HEAVY NUCLEI BY MULTI-CHARGED IONS. Ivo Zvara (Joint Inst. for Nuclear Research, Dubna, USSR). p.389-93 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

Fission fragment yields and charge and mass distributions were determined for ^{22}Ne reactions with ^{238}U at 147 Mev and ^{18}O and ^{22}Ne reactions with ^{232}Th at 105 and 157 Mev, respectively. (C.E.S.)

24736 CONCERNING THE PRODUCTION OF DELAYED PROTON EMITTERS IN REACTIONS BETWEEN COMPLEX NUCLEI. V. I. Goldanskii (Inst. of Chemical Physics, Moscow). p.428-33 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

The possibility of the formation of delayed-proton emitters in reactions between complex nuclei, i.e., the production of nuclei so deficient in neutrons that following their positron decay there occurs the emission of protons from an excited state of the nucleus produced by the positron decay, is considered. (C.E.S.)

24737 SEARCH FOR PROTON EMITTERS AMONG THE PRODUCTS OF HEAVY ION INDUCED REACTIONS. V. A. Karnaukhov, G. M. Ter-Akopian, and V. G. Subbotin (Joint Inst. for Nuclear Research, Dubna, USSR). p.434-7 of "Proceedings of the Third Conference on Reactions Between Complex Nuclei." Berkeley and Los Angeles, University of California Press, 1963.

Evidence is presented for the existence of proton emitters among the products of the ^{20}Ne reaction with Ni at 130 Mev. The proton emitters have an energy from 3 to 4.5 Mev and a half life between 0.1 sec and 5 min. It is supposed that the observed protons are emitted by a nucleus generated in an excited state after β^+ decay. The data obtained was not sufficient to identify the isotope. (C.E.S.)

24738 INTERNAL CONVERSION STUDIES IN THE DECAY OF Ag^{110m}. W. B. Newbolt (Washington and Lee

Univ., Lexington, Va.) and J. H. Hamilton. 20p. (CONF-46-113)

From American Physical Society 1963 Spring Meeting, Washington, D. C., Apr. 1963.

The internal conversion spectrum from the decay of ^{110m}Ag was studied in an iron-free, double-focusing spectrometer. The K and, in some cases, L + M conversion electron intensities were measured for the following transitions in ^{110}Cd; 446.5, 620.2, 657.6, 677.3, 686.5, 706.4, 743.9, 763.6, 818.0, 884.5, 937.4, and 1384.0 kev, and the 433.8 and 613.7 kev transitions in ^{108}Pd. The energies were determined with an accuracy of a few parts in 10^4. The K conversion coefficients of the $2+ \rightarrow 0+$ 657.6, $4+ \rightarrow 2+$ 884.5, and $6+ \rightarrow 4+$ 937.4 kev transitions were measured by the internal-external conversion method to be $(2.64 \pm 0.10) \times 10^{-3}$, $(1.26 \pm 0.06) \times 10^{-3}$, and $(1.12 \pm 0.08) \times 10^{-3}$, respectively. These α_k results are in good agreement with the theoretical values for E2 transitions. (auth)

Plasma Physics and Thermonuclear Processes

24739 (AD-417496) IONIC MOBILITY IN COLD PLASMAS. Final Technical Report, December 1, 1961 to November 31, 1962. (Rome. Università. Istituto di Fisica). Contract DA-91-591-EUC-2031. 18p.

Investigation of the properties of ions in liquid helium, and the use of helium ions in experiments on the rotation of liquid helium, are discussed. All the work was carried out at temperatures in the helium II region, that is, below 2.19°K. The behavior of the positive and negative ions and their interaction with their solvent was studied through measurements of the mobility at various temperatures and applied electric fields. The experiments on rotating liquid helium are described and are grounded on the study of the space charge effect of a beam of negative charges. (auth)

24740 (AD-426769) HIGH-POWER MAGNETICALLY CONFINED PLASMA DUPLEXER. Quarterly Report No. 1, May 31 – August 31, 1963. Edwin Langberg and Wellesley Dodds (Elcon Lab., Inc., Peabody, Mass.). Contract DA-36-039-AMC-02364(E). 58p.

The effect of reduction of ambipolar diffusion across the magnetic field on heat dissipation and gas clean-up of a duplexer filled with Penning mixture of noble gases is calculated. Magnetic confinement geometries of cylindrical, toroidal, mirror and cusp shapes are discussed. The results of preliminary measurements on cylindrical confinement are presented, and an experimental design based on the cusp confinement is described. (auth)

24741 (AFOSR-5367) 'ON THE DOPPLER EFFECT IN A MEDIUM. Technical Report No. 29. K. S. H. Lee (California Inst. of Tech., Pasadena. Antenna Lab.). Dec. 1963. Contract AF49(638)-1266. 88p. (AD-426779)

The problem of calculating the frequency of the wave scattered by a body moving in a medium is formulated from field-theoretic considerations. The Doppler equation for a homogeneous dispersive medium is obtained first. An approximate solution of the equation is obtained and compared with an exact solution for the case of an isotropic plasma. Solutions to the Doppler equations for the case of a gyroelectric medium are found to be of two kinds (discussed). The Doppler equation for an inhomogeneous medium is then derived. Approximate solutions are obtained for isotropic as well as gyroelectric stratified media. (D.C.W.)

24742 (ANL-6802(p.15-18)) PROPERTIES OF GASES AT HIGH TEMPERATURES. A. B. Cambel (Northwestern Univ., Evanston, Ill.).

Experimental and theoretical investigations of the thermodynamic properties of argon, nitrogen, and oxygen plasma for temperatures up to 35,000°K are discussed. (C.E.S.)

24743 (ANL-6802(p.29-36)) DESIGN OF AN EXPERIMENT FOR PRODUCING SUPERSONIC HIGH ELLCTRON DENSITY PLASMA. H. N. Powell (Wisconsin. Univ., Madison).

The experimental design aspects of a research program on electron recombination in cool supersonic (potassium seeded) plasmas are outlined. The problems of producing well-defined conditions and making measurements which require a minimum of independent information for their interpretation are rather severe in plasma work. Considerable effort was expended in these respects and, as several somewhat novel techniques will be tried, a description of the approach is presented. (auth)

24744 (ANL-6802(p.113-19)) PLASMA DIAGNOSTICS USING ELECTROMAGNETIC WAVES. J. T. Verdeyen (Illinois. Univ., Urbana).

The technique of plasma diagnostics using electromagnetic waves is discussed. Equations relating electron number density and collision frequency to the complex dielectric constant and the elastic scattering cross section are given. Typical measurements of the electron temperature as a function of time in a helium afterglow plasma are used to illustrate the method. (C.E.S.)

24745 (ANL-6802(p.120-5)) INVESTIGATION OF DENSE PLASMAS BY LASER RADIATION. J. B. Gerardo and J. T. Verdeyen (Illinois. Univ., Urbana).

The use of lasers for interferometric studies of high density plasma is discussed. The phase information, which shows up as amplitude modulations of the laser output, is considered. It is shown that the sensitivity of the method can be improved considerably by using spherical mirrors for the cavity containing the unknown plasma. (C.E.S.)

24746 (ARL-64-34) EVALUATION OF EXISTING LITERATURE ON THE INTERACTION OF HIGH-DENSITY PLASMA WITH ELECTRIC, MAGNETIC AND FLUID DYNAMIC FIELDS. W. E. Knabe (Space Sciences, Inc., Waltham, Mass.). Feb. 1964. Contract AF33(657)-8761. 393p.

Recent publications on certain aspects of the interaction of plasmas, especially at high densities, with electric, magnetic and fluid-dynamic fields are reviewed. The discussions refer in particular to theoretical and experimental studies of electric arcs. Principles of modern application (plasma acceleration) are also discussed. Abstracts and/or other evaluations of the more significant papers are included. 655 references. (auth)

24747 (CEA-R-2417) LA PREMIERE EXPERIENCE CAPEL. (The First CAPEL Experiment). Pierre Hubert (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Fontenay-aux-Roses). Mar. 1964. 37p. (EUR-545.f)

Electrostatic periodic perturbations producing a resonance effect with Larmor motion, are applied for trapping 1.8-kev electrons in a magnetic mirror bottle. This method gives temporary trapping lasting more than 20 transits. Switching off the perturbations results in complete trapping of temporarily trapped particles. The lifetime of fast electrons with a pressure of 5×10^{-9} mm Hg has a value of 12 ms, which seems to result from non-adiabatic effect losses. At the same pressure, ionization of residual gas by fast electrons produces secondary electrons with a lifetime of 1.5 sec in agreement with evaluations based on elastic scattering losses assumption. (auth)

24748 (CLM-Bib-4) OSCILLATING ELECTROMAGNETIC FIELD INTERACTION WITH, AND CONTAINMENT OF PLASMA. A Bibliography. F. B. Knox and C. S. Sabel, comps. (United Kingdom Atomic Energy Authority. Research Group. Culham Lab., Culham, Abingdon, Berks, England). Mar. 1964. 22p.

References (150) are presented for material issued from 1959 to December 1962. An author index is included. (D.C.W.)

24749 (CONF-521-2) PRELIMINARY RESULTS OF PLASMA MEASUREMENTS ON IMP-A. H. Bridge, A. Egidi, A. Lazarus, E. Lyon (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science; Massachusetts Inst. of Tech., Cambridge); and L. Jacobson (Massachusetts Inst. of Tech., Cambridge. Lincoln Lab.). [1963]. Contract AT(30-1)-2098. 19p.

From 5th Space Science Symposium, Florence, May 1964.

Preliminary IMP-A plasma measurements made with a Faraday cup type instrument are presented. A directed flux of positive plasma ions is always observed in regions beyond the influence of the earth. On each satellite pass two transitions in the plasma properties are usually observed; one transition can be identified with the magnetopause and one with a shock front created by the "supersonic" plasma stream. At the subsolar point, 12:00 hr typical geocentric distances to these regions are 10R and 14R, respectively; on the dawn side of the magnetosphere, 06:00 hr, the corresponding distances are $14R_e$ and $23R_e$. In the transition region between the shock and the magnetopause, a hot isotropic flux of positive plasma ions is observed. Typical values of the directed plasma flux range from $\phi = 1.10^8$ to 1.10^9 cm^{-2} sec^{-1}. Typical values of the bulk velocity range from 250 to 440 km sec^{-1}. (auth)

24750 (EUR-1627.f) UNE DECHARGE DANS LA VAPEUR DE LITHIUM. (High Vacuum Lithium Discharge [Lithium Vapor Discharge]. M. Fumelli (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Fontenay-aux-Roses). 1964. 38p. (CONF-38-11)

From American Physical Society Division of Plasma Physics 4th Annual Meeting, Atlantic City, Nov.-Dec. 1962.

A highly ionized, steady-state lithium plasma column, 50 cm long and 5 cm in diameter, was achieved in a magnetic mirror geometry by a reflex discharge in lithium vapor. The vapor was supplied to the hot hollow cylindrical anode by a controlled-temperature oven. With a vapor feed of 2.5×10^{-4} g/sec, a magnetic field of about 1250 to 2500 gauss, and a discharge current up to 5 amp at about 400 v, plasma densities above 10^{12} particles/cm^3 near the axis and electronic temperatures of about 2 ev were measured by Langmuir probes. The minimum gas pressure around the column was 1.5×10^{-7} mm Hg. Mass spectrometric analysis of the plasma ions showed the existence of Li^+ and Li^{2+} but not of Li^{3+}. Discharge conditions may be governed to adjust the relative abundances of Li^+ and Li^{2+} and, in particular, to obtain a preponderance of Li^{2+}. (auth)

24751 (EUR-CEA-FC-200) IONIZATION AND RECOMBINATION IN A HYDROGEN-, HELIUM- AND LITHIUM PLASMA UNDER STEADY STATE CONDITIONS. Hans-Werner Drawin (European Atomic Energy Community and France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). Mar. 1963. 42p.

The degree of ionization and the particle densities (neutrals, ions, and electrons) of H, He, and Li plasmas both in local thermal (thermodynamic) equilibrium and in thermal non-equilibrium were calculated, assuming that a steady state had been established. Relaxation times for ionization and spontaneous recombination of the plasma were also calculated. A Maxwellian velocity distribution of the electrons was assumed for all calculations. The formulas are given, and the results are presented. (D.C.W.)

24752 (MATT-217) A CALCULATION OF THE SPECTRAL DENSITY OF RADIATION SCATTERED BY A NON-EQUILIBRIUM PLASMA WHICH IS VALID FOR ALL WAVENUMBERS. Ronald L. Fante (Princeton Univ., N. J. Plasma Physics Lab.). Oct. 1963. Contract AT(30-1)-1238. 58p.

A formula is derived for the spectral density $S(\underline{k},\omega)$ of radiation scattered by a non-equilibrium plasma, which is valid for all wavenumbers k. The spectrum obtained is equal to the spectrum obtained by Rostoker plus a correction term which is important for large k. (auth)

24753 (N64-13056) ON THE "TEST PARTICLE" PROBLEM FOR AN ELECTRON PLASMA. D. A. Tidman and David Montgomery (Maryland. Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics). Dec. 1963. 9p. (NASA-CR-55147; BN-342)

Fokker-Planck coefficients for a test particle distribution in an equilibrium electron plasma are calculated from the generalized Balescu-Lenard equation. The results disagree slightly with those of Rostoker and Rosenbluth. (auth)

24754 (NASA-TN-D-2278) ANALYTICAL INVESTIGATIONS OF COIL-SYSTEM DESIGN PARAMETERS FOR A CONSTANT-VELOCITY TRAVELING MAGNETIC WAVE PLASMA ENGINE. Raymond W. Palmer, Robert E. Jones, and George R. Seikel (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). May 1964. 35p.

Results of an analytical study of the design parameters are presented for one of the simplest methods of producing a traveling magnetic wave. This method is to excite a linear array of coils with polyphase radiofrequency electric current. The exact and approximate equations that describe the axial and the radial components of the magnetic field are developed with the presence of a plasma neglected. The approximate equations are shown to be valid for a value of the accelerator to coil radius ratio as large as 0.5. A Fourier decomposition of the total magnetic wave shows that this wave is composed of an infinite series of waves of diminishing amplitude running opposite to each other at different velocities. The presence of magnetic waves other than the design magnetic wave, as well as the variation of the average magnetic intensity level, forms the basis for the definition of a quality factor with which all similar coaxial coil systems may be compared. For a given amount of coil power consumption, the greatest amount of magnetic energy available for useful plasma acceleration occurs at a coil-radius to magnetic-wave-wavelength ratio of 0.3 for a value of accelerator-coil radius ratio of zero (centerline). This optimum value is increased to 0.35 when the accelerator-coil radius ratio is increased to 0.5. At this optimum value, the useful energy in the magnetic wave is independent of the number of phases per wavelength when that number is greater than three. The quality factor also applies as an approximate scaling law and indicates that properly designed larger coil systems will produce the magnetic energy more efficiently than smaller systems. (auth)

24755 (NP-13895) SUMMARY OF SHERWOOD ACTIVITIES. Supplementary Report. (Defense Atomic Support Agency. Field Command, Albuquerque, N. Mex.). Feb. 15, 1964. 64p.

The research in progress and the experimental devices used in the Sherwood program are described. (C.E.S.)

24756 (NP-13946) USE OF GUARD RING SHIELDS ON NEGATIVELY BIASED LANGMUIR ION COLLECTION CURRENT PROBES. G. S. Janes and J. P. Dotson (Avco Corp. Avco-Everett Research Lab., Everett, Mass.). Apr. 1964. Contract AF49(638)-659. 5p. (AMP-137)

A shielded ion collection probe is described that provides a constant effective ion collection area, which is useful for diagnostics of plasma properties varying in time and space. The probe is biased at a potential low enough to reject the highest temperature electrons encountered during a traverse through plasma regions of widely varying voltage gradients, electron temperatures, and ion-current densities. (R.E.U.)

24757 (NP-13948) THE PRODUCTION OF HIGHLY EXCITED NEUTRAL ATOMS FOR INJECTION INTO PLASMA DEVICES. [PART] I. S. T. Butler and I. D. S. Johnston (Sydney. Univ. School of Physics). Mar. 1964. 45p. (TR-3)

The cross section for excited-state formation for $H^+ + H(1s) \rightarrow H(\text{excited}) + H^+$ was investigated using the Born approximation. (R.E.U.)

24758 (NP-13949) THE PRODUCTION OF HIGHLY EXCITED NEUTRAL ATOMS FOR INJECTION INTO PLASMA DEVICES. [PART] II. Robert M. May (Sydney. Univ. School of Physics). Mar. 1964. 38p. (TR-4)

In a preceding paper (TR-3, NP-13948), Butler and Johnston found a giant resonance in the total cross section for charge-exchange, which they calculated by summing over all final states, for $H^+ + H(1s) \rightarrow H(N,l) + H^+$. It is shown that the Born approximation used in their calculation is valid for excited states near the resonance; the resonance is not due to a breakdown in perturbation theory. A further understanding of the origin of the resonance is obtained by calculating the cross section for individual highly excited final states. For a given principal quantum number N, away from the resonance only the state with angular momentum quantum number l = 0 contributes; the resonance arises because in its neighborhood all (N^2) angular momentum states contribute equally. It is shown that Butler and Johnston are correct in not including the proton-proton interaction in their perturbation matrix elements. (auth)

24759 (NP-13950) COLLISION DAMPING OF TWO-STREAM INSTABILITIES IN A PLASMA. Robert M. May (Sydney. Univ. School of Physics). Mar. 1964. 13p. (TR-5)

Doubt exists as to whether the Gross-Krook collision model is adequate to describe the collisional damping of two-stream instabilities for a stream of electrons passing through a background of ions. It is shown here that the model is indeed adequate: the instability ceases to grow after a time of the order of one collision time. (auth)

24760 (NP-13951) RELAXATION OF A FAST ION IN A PLASMA. Robert M. May (Sydney. Univ. School of Physics). Mar. 1964. 17p.

The relation between a simple calculation (making no use of a distribution function) by Butler and Buckingham and previous work on relaxation processes (based on the Boltzmann or the Fokker-Planck equations) is examined. The Butler-Buckingham calculation is shown to correspond rigorously to a specific approximation to the distribution function of the test particle. This approximation is shown to be valid for particles of high energy which relax by many small collisions. This approximation, in conjunction with its opposite extreme (the Mott-Smith approximation), covers essentially all relaxation problems. (auth)

24761 (NP-13952) A NOTE ON THE ELECTRICAL CONDUCTIVITY OF A LORENTZ GAS. Robert M. May (Sydney. Univ. School of Physics). Mar. 1964. 6p.

An expression for the electrical conductivity of a Lorentz gas in a time-dependent electric field is derived directly from the Fokker-Planck equation by taking an unusual velocity moment. An arbitrary zero-order distribution function is used. (auth)

24762 (UCRL-7077) FINITE-RESISTIVITY INSTABILITY OF A TUBULAR SHEET PINCH. Charles E. Kuivinen (California. Univ., Livermore. Lawrence Radiation Lab.). May 28, 1963. Contract W-7405-eng-48. 10p.

The theory of finite-resistivity hydromagnetic stability predicts a long-wave tearing mode that corresponds to the breakup of a sheet pinch into adjacent linear pinches. The instability was observed in a triaxial pinch tube using magnetic probes and Kerr cell photography. Measurements were made on both argon and deuterium pinches. The results are in qualitative agreement with the theoretical predictions. (D.C.W.)

24763 (UCRL-11172) CONTROLLED THERMONUCLEAR RESEARCH SEMIANNUAL REPORT, JULY THROUGH DECEMBER 1963. (California. Univ., Berkeley. Lawrence Radiation Lab.). Jan. 30, 1964. Contract W-7405-eng-48. 104p.

A summary is presented of studies on: development of magnetic-mirror, Astron, and pinch devices; experimental and theoretical plasma physics; and related engineering and technological developments. (T.F.H.)

24764 (UTIAS-Rev-18) MECHANICS OF RAREFIED GASES AND PLASMAS. A State-of-the-Art Survey of Some Aspects. Final Report. G. N. Patterson (Toronto. Univ. Inst. for Aerospace Studies). Mar. 1964. Contract AF33(616)-6990. 211p.

A survey of some aspects of the kinetic theory of rarefied gases (neutral molecules) and a brief introduction to the characteristics of ensembles of identical charged particles are presented. The derivation and properties of the Boltzmann equation are considered. The special form of the Boltzmann equation for free molecule flow and the associated boundary conditions governing the distribution function are discussed. The latter involves the interaction of gas particles with surfaces. The free molecule flux of particles at an orifice and an element of surface of a body are considered, and results are applied to determine the aerodynamic properties of a sphere in a highly rarefied gas. The theory of free molecule motion is extended to include multiple collisions with surfaces. The particular case of the flux of molecules through a tube was calculated with emphasis on radial distributions of mass transfer. Near-free-molecule flow is introduced by a consideration of molecular beams and the effect of collisions on beam strength. Molecular beam systems are reviewed from the point of view of design. An integral equation form for the Boltzmann relation, which facilitates an iterative method of solution, is shown to be a suitable basis for a study of the properties of near-free-molecule flow. However, this method requires the use of a kinetic model of the Boltzmann equation if the problem is to remain mathematically tractable. The required equations to be used for investigating the aerodynamics of isolated bodies in near-free-molecule flow are then discussed. Various analytical solutions of the heat flow between parallel walls are given, and the Monte Carlo method is summarized. Finally, the Boltzmann equation was reconsidered in detail for the more general case of an ensemble of identical charged particles. Relativistic effects are included. The distribution function for particles under the action of external forces is considered. 77 references. (auth)

24765 (JPRS-24633(p.43-61)) KINETIC EQUATIONS FOR PLASMA ELECTRONS AND THE PHOTONS RADIATED BY THEM IN A STRONG MAGNETIC FIELD. V. G. Bar'yakhtar and S. V. Peletminskii. Translated from Izv. Vyssikh Uchebn. Zavedenii, Radiofiz., 6: 1115-28(Nov.-Dec. 1963).

The kinetic equations for the electrons and photons in an inhomogeneous plasma in a strong magnetic field are derived, taking into account the absorption and emission of electromagnetic waves by the electrons. The electron current, current density, and energy flux are obtained. (D.C.W.)

24766 (JPRS-24633(p.62-77)) WAVE TRANSFORMATION ON A PLASMA BOUNDARY IN A MAGNETIC FIELD. V. M. Kontorovich and I. M. Kutik. Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 6: 1129-39(Nov.-Dec. 1963).

The transformation of longitudinal and transverse waves into each other on a plasma boundary both in a weak and (for transverse propagation) an arbitrary magnetic field is investigated. In a weak field, the transformation coefficients have a characteristic maximum in their angular dependence; the magnitude, position, and width of the peak depend on the frequency. (auth)

24767 (KFK-tr-141) ÜBER DIE INJEKTION HOCHENERGETISCHER TEILCHEN IN EINE SPIEGELMASCHINE UND ÜBER DIE PROTONENAKKUMULATION. (On the High-Energy Injection of Particles in a Mirror Machine). Cheng-wu Li. Translated into German by Peter Buriks from Wu Li Hsueh Pao, 18: 586-93(1962). 20p.

A method by which H_2^+ and H^0 beams were injected into a mirror machine is reported. From the analysis of the residual gas transformations in the system the fundamental equation for the accumulation rate of the protons was obtained. Moreover, the conditions for exponential increase of the proton density were found. An analysis of the operating parameters of the system showed that in the energy range 10 to 100 kev a strong magnetic field is helpful for the accumulation of the investigated particles. However the choice of the optimum energy still presents difficulties. The views of Post et. al., that a low energy is possibly best, leads to complications: experimentally determined conditions show that a relatively high energy is advantageous. (tr-auth)

24768 BASIC EQUATIONS OF MAGNETOFLUIDODYNAMICS IN ANISOTROPIC MEDIA. I. Abonyi (Roland Eötvös Univ., Budapest). Acta Phys. Acad. Sci. Hung., 17: 91-5(1964).

After giving a brief review of the fundamental equations of magnetofluido-dynamics and their limits of validity, the basic equations are derived for the case of media characterized by anisotropic conductivity and electric and magnetic permeability. The material quantities are supposed to be given tensor expressions with a nonvanishing determinant. (auth)

24769 ROTATING ELECTRICALLY CONDUCTING FLUIDS IN A LONG CYLINDER. Kwadwo O. Kessey (Columbia Univ., New York). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 864-71(May 1964).

A hydromagnetically generated vortex in an incompressible, viscous, cylindrically confined plasma is analyzed. Solutions for steady laminar one- and two-dimensional flow fields are obtained. The two-dimensional flow field involves impressed radial mass flow. The solutions for the pressure of the flow field with impressed radial mass flow are valid for small magnetic Reynold's number only. Results are given which are applicable to a gaseous nuclear rocket. (auth)

24770 ANONYMOUS DESCRIPTION AND HYDRODYNAMICAL APPROXIMATION FOR A CLASSICAL PLASMA. W. Macke and B. Pegel (Technische Universität, Dresden). Ann. Physik (7), 12: 398-408(Feb. 1964). (In German)

An expanded gas consisting of point-like, electrically charged particles without magnetic interaction was studied. By means of a canonic transformation an equivalent, anonymous characterization was derived from which, in turn, a system of macroscopical hydrodynamical equivalence equations was developed. By approximating certain oscillation terms, a system of hydrodynamical equations was derived. Finally, an equation was arrived at for the characterization of anisotropic pressure conditions during rapid changes in the state of the system. (auth)

24771 THE BEHAVIOR OF THE RESONANCE PROBE IN A PLASMA. R. S. Harp (Stanford Univ., Calif.). Appl. Phys. Letters, 4: 186-8(June 1, 1964).

An analysis of the resonance probe is presented, with supporting experiments, explaining the resonance and showing that it occurs below the plasma frequency. The experimental method used was to measure the fields in the vicinity of the probe with an electron beam probe. (R.E.U.)

24772 HIGH-INTENSITY MICROWAVE NOISE RESONANCES FROM ACTIVE RARE GAS DISCHARGES. C. D. Lustig (Sperry Rand Research Center, Sudbury, Mass.). Appl. Phys. Letters, 4: 194-6(June 1, 1964).

The emission of microwave radiation from He, Ne, Ar, Kr, and Xe discharge columns was studied using a swept-frequency narrow-band superheterodyne receiver. Gas pressures were at 1 to 100 μ. Well-defined, high-intensity resonances were observed in the emission spectra. (R.E.U.)

24773 THE FREE PATH LENGTH IN AIR PLASMA. CALCULATION RESULTS. Kl. K. Neumann and K.-U. Hoffmann (Technische Hochschule, Brunswick). Ber. Bunsenges. Physik. Chem., 68: 181-4(1964). (In German)

Two different theoretical approaches (two-body problem method, theory of co-operative interaction) were used to calculate the mean free path (which is important in the calculation of all transport coefficients) from data evaluated for the equilibrium composition of thermal air plasmas. The results are reported in diagrammatic form. (auth)

24774 THE PHYSICAL MECHANISM OF THE PLASMOID AT HIGH FREQUENCY. Joseph Taillet. Compt. Rend., 258: 2031-3(Feb. 17, 1964). (In French)

The dipolar resonance of low-pressure plasmas maintained by high frequency can, in the presence of traces of electronegative gases, lead to the production of negative ions, which are accumulated at the center of the plasma and modify the form of the potential distribution. There is thus created a zone of uniform electron density. This zone is isolated by a well-defined frontier of the wide ionic sheath at low electron density, which separates it from the walls. (tr-auth)

24775 THE GENERATION OF SUPERFAST PLASMA BUNDLES IN A LINEAR ACCELERATOR. L. V. Dubovoi and Yu. E. Nesterikhin. Dokl. Akad. Nauk SSSR, 154: 1310-13(Feb. 21, 1964). (In Russian)

A highly ionized plasma was injected into an accelerator. The discharge current through the source had the shape of an aperiodic pulse 2.5 μsec in duration. The amount of material injected into the accelerator could be varied from 1 to 60 μg by changing the discharge current from 25 to 200 ka. The average energy of the injected particles was 10 to 15 ev. The plasma was injected into the accelerator at a point 30 cm from the dividing, coaxial insulator at an initial velocity of 5×10^3 m/sec. The average particle density in the plasma bundle was 10^{14} cm^{-3}, as determined with a pair of electric probes at the accelerator exit. The plasma velocity increased with decreasing mass of injected material. Velocities of 3 to 5×10^6 m/sec were observed on accelerating <1 μg of material, but the conversion efficiency and reproducibility of the experimental results were poor at these high velocities. The acceleration time of the plasma bundle is limited to about 10^{-6} sec because of radial particle diffusion in the coaxial accelerator. (TTT)

24776 THE CATHODIC SPUTTERING OF TUNGSTEN BY MEANS OF POTASSIUM IONS. U. A. Arifov, A. Kh. Ayukhanov, V. A. Shustrov, R. M. Khasanov, and V. I. Poltoratskii (Inst. of Tech., Academy of Sciences, Uzbek SSR). Dokl. Akad. Nauk SSSR, 155: 306-8(Mar. 11, 1964). (In Russian)

A polycrystalline tungsten target containing induced ^{184}W activity as a tracer was used to determine the amount of sputtered tungsten. If a positive potential was applied between the target and the collector, no differences in sputtering could be observed compared to a potential V = 0, but with a negative potential of V = −300 volts, the amount of sputtered material decreased significantly. This behavior indicated that a significant part of the sputtered tungsten consists of negative ions. The percent of sputtered tungsten in the form of neutral and negative ions was plotted as a function of the energy of the K^+ ions, which was varied from 750 to 2500 ev. On raising the temperature of the target to $T > 1200$°K, the film of alkali metal was evaporated away, and the sputtering of negative ions practically ceased. The cathodic sputtering coefficient no longer depended on temperature at temperatures $T > 1600$°K. Sputtering of a pure metallic tungsten surface was involved under these conditions of high temperature. The sputtering coefficient of a pure tungsten surface at 1800°K increased linearly with increasing energy of the K^+ ion. (TTT)

24777 THE GROUP VELOCITY OF SLOW WAVES IN DRIFTING MAGNETICALLY ACTIVE PLASMA. A. V. Gulel'mi (Gul'yel'mi) (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 607-10 (1963).

An expression for the refractive index is derived which, along with the expressions for the group velocity vector and angle, allows the problem of the direction and velocity of propagation of an electromagnetic signal in drifting plasma to be solved. Expressions for drift-induced corrections for the group velocity and angle are also determined and graphically analyzed. (L.B.S.)

24778 LOW-FREQUENCY WAVES IN MULTICOMPONENT PLASMA. M. A. Gintsburg (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 610-14(1963).

The dependence of the refractive index and absorption coefficient on the relative concentrations of ions in a multicomponent plasma is studied. The influence of the chemical composition of the plasma on the propagation of electromagnetic waves is used in an investigation of the earth's atmosphere. Expressions for the refractive index for propagation of Alfvén waves are discussed, and the influence of ion composition on oscillations in bounded multicomponent plasma are considered. (L.B.S.)

24779 RESEARCH ON FUSION—STATEMENT OF PROGRESS REALIZED IN THE COURSE OF THE LAST TWO YEARS. J. G. Linhard (Euratom-CNEN, Frascati, Italy). Ind. At., 8: 71-8(1964). (In French)

To clarify the account of progress achieved in 1962 and 1963 for the control of the fusion process, experiments are classified into three types: those with continuous confinement of the plasma, those with a very short confinement time, and those aimed at obtaining very dense plasmas with hardly any confinement. It is possible to compare experiments of all three types, using an nτ,T diagram. (auth)

24780 ON PLASMA INSTABILITIES AND THEIR PROBABLE ROLE IN IONOSPHERIC PHENOMENA. D. Lepechinsky and P. Rolland (Centre d'Etudes Nucléaires, Saclay, France). J. Atmospheric Terrest. Phys., 26: 31-40(Jan. 1964).

A brief survey is presented of the important problems of plasma instabilities and of the criteria available for internal instabilities. It is shown that a beam of solar particles penetrating the ionosphere will eventually excite enhanced plasma oscillations in the lower frequency band and generate an electromagnetic noise detectable on the ground. This concept explains the so called VLF omission and also leads to a new interpretation of the ionospheric "wind" phenomenon. (auth)

24781 PLASMA DIFFUSION IN THE IONOSPHERE. S. Chandra (Goddard Space Flight Center, Greenbelt, Md.). J. Atmospheric Terrest. Phys., 26: 113-22(Jan. 1964).

Equations of motion appropriate to the conditions existing in the ionosphere are discussed with a view to examining the condition for ambipolar diffusion ($v_e = v_i$). It is shown that for quasi-equilibrium and isothermal conditions the required condition for ambipolar diffusion is given by curl $v \times B = 0$. It is further shown that the assumption of ambipolar diffusion along the field lines leads to the trivial situation of hydrostatic distributions of electron density independent of latitude. These results are not in agreement with the generally accepted view that diffusion of the plasma along the direction of the magnetic field can account for many geophysical phenomena in the ionosphere. This disagreement is attributed to the fact that the assumption of field-aligned plasma diffusion puts a constraint on grad n_e which previously was not taken into account. It is pointed out that the solutions of v_e and v_i in terms of the particle densities and temperatures are not possible without the knowledge of the electric field. (auth)

24782 THE PROBE MEASUREMENTS OF PROPRIETY OF PLASMOIDS CREATED IN A COAXIAL PLASMA GUN. Stefan Chwaszczewski (Inst. of Nuclear Research, Warsaw). Nukleonika, 9: 19-29(1964). (In Russian)

Measurements and the apparatus for determining the velocity of plasmoids, electron temperature, and plasma density in a coaxial injection gun are described. Results were obtained by means of single electrostatic probes of the Langmuir type. It was discovered that two kinds of plasmoids exist, namely slow and fast ones. (P.C.H.)

24783 SOME CONTRIBUTIONS OF RUBY LASER LIGHT SOURCE TO THE STUDY OF THE PLASMA REFRACTIVITY. U. Ascoli-Bartoli, S. Martellucci, and E. Mazzucato (EURATOM-CNEN, Frascati, Italy). Nuovo Cimento (10), 32: 298-316(Apr. 16, 1964).

The new possibilities revealed by the use of the ruby laser as a source of light in the study of the refractivity of a plasma in the optical region are examined. The new experimental limits of the optical methods commonly used in the optical diagnostics of ionized gases are discussed, and the limits set by the internal structure of the plasma are also examined. New optical methods, made possible by the use of sources of the laser type, are also dealt with and among them the shadow method that permits to reveal the presence of turbulent phenomena in a plasma. (auth)

24784 SPECTROSCOPIC OBSERVATION OF THE UNSTABLE REGIME DURING THE TRANSITION FROM WEAK TO STRONG HIGH-FREQUENCY DISCHARGE. O. P. Bochkova and L. P. Razumovskaya. Opt. i Spektroskopiya, 15: 716-18(1963).

Weak and strong discharges were investigated in argon, helium, and neon gases as functions of gas pressure and discharge tube diameter. It was found that in the transition from weak to strong discharge there is an unstable regime within a narrow pressure interval where oscillations occur in the discharge. The instability is clearly apparent when spectral line brightness is plotted as a function of pressure. (AID Press)

24785 ON THE ELECTRICAL CONDUCTIVITY OF A LORENTZ GAS. R. M. May (Univ. of Sydney). Phys. Letters, 9: 314-15(May 1, 1964).

A plasma sufficiently near equilibrium for the electron and ion thermal energies to be of the same order may be considered a Lorentz gas if only electron—ion collision are considered in estimates of transport coefficients. An unusual velocity moment of the Fokker-Planck equation is used to get directly an expression for the conductivity of a Lorentz gas in a time-dependent field, with an arbitrary zero-th-order distribution function. (R.E.U.)

24786 MICROWAVE NOISE RESONANCES FROM A PLASMA COLUMN. C. D. Lustig (Sperry Rand Research Center, Sudbury, Mass.). Phys. Letters, 9: 315-17(May 1, 1964).

Quantative measurements of resonances in the noise spectrum radiated by a d-c discharge were made. It is shown that the measurements agree with those expected for Tonks-Dattner resonances in the microwave absorption and reflection spectra of a hot plasma column, which are attributed to electrostatic oscillations at frequencies for which the nonuniform plasma represents a resonant structure. (R.E.U.)

24787 STABILITY OF LONGITUDINAL OSCILLATIONS IN A UNIFORM MAGNETIZED PLASMA WITH ANISOTROPIC VELOCITY DISTRIBUTION. Laurence S. Hall and Warren Heckrotte (Univ. of California, Livermore). Phys. Rev., 134: A1474-5(June 15, 1964). (UCRL-7627)

The longitudinal oscillations of a uniform magnetized plasma in which the particles are allowed to have anisotropic distributions in velocity space, corresponding to the two temperatures $T_\perp$ and $T_{||}$ perpendicular and parallel to the magnetic field are considered. It is shown that no instabilities can exist unless $T_\perp > T_{||}$ for at least one of the species of plasma particles. An additional theorem, of use in surveying for possible unstable roots to the dispersion equation when $T_\perp > T_{||}$, is also proved. (auth)

24788 LIGHT-OFF-LIGHT SCATTERING IN A PLASMA. P. M. Platzman (Bell Telephone Labs., Murray Hill, N. J.), S. J. Buchsbaum, and N. Tzoar. Phys. Rev. Letters, 12: 573-5(May 25, 1964).

Light-off-light scattering is compared with coherent, inelastic scattering of a single-light beam from a plasma. The inelastic light-scattering experiment involves the available density of final "plasmon" states; in the light-off-light scattering the number of counts near the resonance is determined solely by the spectral width of the probing beams. The ratio of the total number of scattered photons in the two cases is calculated. It is concluded that in the light-off-light scattering experiment near a resonance, not only can larger counting rates be obtained, but because two scattered beams are present, coincidence techniques or modulation and phase-synchronous detection techniques can be used to discriminate against background. (L.B.S.)

24789 KINETIC EQUATIONS FOR A HOMOGENEOUS PLASMA INTERACTING WITH A RADIATION FIELD. A. Mangeney (Institut d'Astrophysique, Paris). Physica, 30: 461-74(Mar. 1964). (In French)

Methods developed by Prigogine and coworkers are applied to the case of a plasma interacting with a radiation field. Expansion in powers of n_D^{-1} (where n_D is the number of particles in the Debye sphere) is used to show that, to the first order, the particles tend toward a Maxwellian equilibrium independently of the radiation field. Thomson diffusion and bremsstrahlung in the plasma are studied to the order n_D^{-2}. (tr-auth)

24790 CYCLOTRON INSTABILITIES IN A PLASMA STREAM AS A MECHANISM FOR WAVE AMPLIFICATION. C. F. Knox (Cambridge Univ., Eng.). Proc. Phys. Soc. (London), 83: 783-801(May 1964).

An analysis is made of the interaction between cold streams of charged particles flowing along a uniform, steady, magnetic field. The special case is considered of plane waves propagating along the field, when the dispersion equation always separates into two transverse modes and a longitudinal mode. Resonance between transverse waves and the gyromotions of the streaming particles results when the particles observe the wave to have a frequency equal to their gyrofrequency. Under such conditions cyclotron instabilities may arise. It is shown that wave amplification from convective instabilities is possible if the stream velocity is in the same direction as the group velocity, but greater in magnitude than the phase velocity, of the transverse waves which propagate in the ambient medium. Results are applied to particle streams in the exosphere of the earth, and it is concluded that noise in the very low frequency range will be amplified by ion streams in the presence of ambient electrons, or by electron streams in the presence of ambient protons. For slow streams ($V/c < 1/50$) the amplified frequencies will have a narrow bandwidth centered close to the gyrofrequency of the ambient particles. (auth)

24791 EMISSION-LINE PROFILE MEASUREMENTS IN TRANSIENT PLASMAS, USING A SCANNING FABRY-PÉROT INTERFEROMETER. N. J. Peacock (United

Kingdom Atomic Energy Authority, Abingdon, Berks, Eng.), J. Cooper, and J. R. Greig. Proc. Phys. Soc. (London), 83: 803-10(May 1964).

A scanning Fabry-Pérot interferometer was used to record the profiles of hydrogen and helium lines emitted by the plasma produced in a critically damped Z pinch. Individual line profiles were recorded in less than one microsecond while many profiles of the same line were recorded in successive time intervals during the course of a single discharge. Broadening of the lines was caused mainly by plasma microfields and so interpretation according to Stark broadening theory has led directly to the electron density. Results obtained with the Fabry-Pérot interferometer were compared with those obtained with other diagnostic techniques over the range $10^{14} \leq n_e \leq 10^{17}$ cm^{-3}. (auth)

24792 THE RADIO-FREQUENCY EMISSION COEFFICIENT OF A HOT PLASMA. R. P. Mercier (Univ. of Bristol, Eng.). Proc. Phys. Soc. (London), 83: 819-22 (May 1964).

The spectrum of radio-frequency radiation from a fully ionized ion-electron plasma is calculated, starting from the dependence of the dipole moment on the particle-particle Coulomb fields. These Coulomb fields are shielded according to the usual dielectric constant theory. The acceleration of a particle by others of like species gives rise to quadrupole radiation only; thus the second derivative of the dipole moment depends on the sum of ion-electron forces. It is simplest to find the total force acting on each ion due to all the electrons, and then to sum over the ions. Ion-ion correlation may be allowed for readily. The result agrees with calculations made by Dawson and Oberman and others whose approach was via the absorption coefficient and Kirchhoff's law. (auth)

24793 RECOMBINATION AND ENERGY BALANCE IN A DECAYING PLASMA. I. $H-H^+-e$ PLASMA. D. R. Bates (Queen's Univ., Belfast) and A. E. Kingston. Proc. Roy. Soc. (London), Ser. A, 279: 10-31(May 12, 1964).

The thermal economy of a decaying $H-H^+-e$ plasma is discussed in detail, particular attention being paid to a plasma which is magnetically confined so that only the atoms can strike the containing walls. It is pointed out that the relaxation times for the temperatures, T_e and T_i, of electrons and ions are commonly shorter than the relaxation times for the number densities, n(c) and n(l), of electrons and atoms, so that as the plasma decays these temperatures fall through quasi-equilibrium values. The quasi-equilibrium T_e and T_i and the corresponding collisional-radiative recombination coefficient α are calculated for a wide range of optically thin and optically thick plasmas. A comparison is made with the experimental data of Hinnov and Hirschberg. Satisfactory agreement is obtained. Very dense plasmas in which ionizing collisions are important are briefly considered. (auth)

24794 RECOMBINATION AND ENERGY BALANCE IN A DECAYING PLASMA. II. He-He-e PLASMA. D. R. Bates (Queen's Univ., Belfast) and A. E. Kingston. Proc. Roy. Soc. (London), Ser. A, 279: 32-8(May 12, 1964).

The quasi-equilibrium electron and ion temperatures and the corresponding collisional-radiative recombination coefficient in magnetically confined decaying $He-He^+-e$ plasmas are calculated using an approximate version of a method described earlier. The results are in quite good accord with experimental data of Motley and Kuckes and of Hinnov and Hirschberg. (auth)

24795 ON THE ROLE OF DIFFUSION AND VISCOUS FRICTION IN PLASMA ACCELERATION PROCESSES. V. Yu. Baranov and A. K. Musin. Radiotekhn. i Elektron., 9: 283-92(Feb. 1964). (In Russian)

Plasma cluster motion in a rail-type accelerator was estimated considering diffusion scattering of the cluster mass and the influx of new particles during the erosion of guiding electrons. (tr-auth)

24796 EFFECTS OF HIGH-FREQUENCY ELECTRIC FIELD ON GLOW DISCHARGE. V. M. Tkachenko, V. N. Kostin, and V. V. Velous (Kharkov State Univ.). Radiotekhn. i Elektron., 9: 293-9(Feb. 1964). (In Russian)

Theoretical studies of positive column constriction as a function of frequency are in good agreement with experimental observations on hydrogen, deuterium, and air at 10 to 220 kc. Variations of ion and electron currents, potentials, temperatures, and electron concentrations in high-frequency fields were determined by probe measurements on discharges at 0.1 to 4 mm Hg gas pressures. (tr-auth)

24797 PERFORMANCE OF MAGNETIC THERMONUCLEAR REACTOR. V. L. Ginzburg. Tr. Fiz. Inst., Akad. Nauk SSSR, 18: 55-104(1962). (In Russian)

Elementary processes in plasma are reviewed, and the possible role of deuterium and tritium ionization and dissociation are discussed. Laminar instability and turbulence in an infinitely long tube are investigated. (R.V.J.)

24798 OF THE POSSIBILITY OF SPECTROSCOPIC OBSERVATION OF ELECTRON-RAY MELTING. E. V. Lifshitz (Inst. of Physics and Tech., Khar'kov). Ukr. Fiz. Zh., 9: 207-9(Feb. 1964). (In Ukrainian)

The possibility of continuous observation of electron-ray melting by the plasma emission spectra is considered. The plasma is formed as a result of ionization by an electron beam of the gas and of the vapors of the melting metal. Atomic excitation originates both from collision with the beam electrons and from vibration excitation caused by the beam passing through the plasma. As a result of these excitations the plasma electrons obtain energy enough to ionize and excite the plasma atoms and ions. The method is applicable in the case when the pressure in the melting chamber is enough to form the plasma. (auth)

24799 A METHOD OF GEOMETRIC OPTICS IN ELECTRODYNAMICS OF INHOMOGENEOUS PLASMA. A. A. Rukhadze and V. P. Silin. Usp. Fiz. Nauk, 82: 499-535 (Mar. 1964). (In Russian)

A review is given of geometric optics of electrodynamic media with spatial dispersion and tensor dielectric penetrability, and a geometric optics method is developed for weakly inhomogeneous plasma confined by a strong magnetic field. The spectrum of natural plasma oscillations described by Bohr-Sommerfeld phase integrals (quasi-classical quantization rules) were analyzed, and conditions for instability were found. (R.V.J.)

24800 SKIN EFFECT IN A HIGH FREQUENCY RING DISCHARGE. R. A. Demirkhanov, I. Ya. Kadysh, and Yu. S. Khodyrev. Zh. Eksperim. i Teor. Fiz., 46: 1169-77(Apr. 1964). (In Russian)

The skin effect in a stationary high frequency discharge is studied at frequencies of 0.9, 4.6, and 5.6 Mc. The following limiting cases for the ratio between the field oscillation frequency and electron collision and ratio between the frequency, skin layer thickness, and electron mean free path are experimentally realized: $\omega/\nu_{eff} \ll 1$, $\omega/\nu_{eff} \gg 1$, and $\delta/l \gg 1$, $\delta/l < 1$. It is shown that the character of penetration of the field in the plasma depends on the case considered. In the discharge region near the axis a penetration anomaly was found which consists in growth of the field amplitude as it penetrates into the plasma. The conditions of existence of the anomaly are determined. (auth)

24801 RECOMBINATION COEFFICIENT IN A DENSE LOW TEMPERATURE PLASMA. A. V. Gurevich and L. P. Pitaevskii (Lebedev Inst. of Physics, Moscow and Inst. of Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 46: 1281-4(Apr. 1964). (In Russian)

The electron recombination coefficient in a multicharged partially ionized gas is calculated for the case when the energy is transferred in electron-electron collisions and the equilibrium distribution in momentum directions is established, as a result of collisions with neutral atoms, more rapidly than the energy distribution. The formulas can be extended to the case of a singly charged completely ionized gas. (auth)

24802 ON THE THEORY OF INTERACTION BETWEEN CHARGED PARTICLES AND A NONEQUILIBRIUM PLASMA. I. A. Akhiezer and Yu. L. Bolotin (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 46: 1331-4(Apr. 1964). (In Russian)

The interaction between a charged particle and nonequilibrium plasma is investigated. It is shown that if the plasma is in a state close to instability, energy losses of the particle due to excitation of plasma oscillations may be anomalously large. (auth)

24803 UNIVERSAL INSTABILITY IN THE POTASSIUM PLASMA. N. S. Buchel'nikova. Zh. Eksperim. i Teor. Fiz., 46: 1147-8(Mar. 1964). (In Russian)

In plasma with a nonuniform density, the so-called "universal" instability may be induced in the presence of a magnetic field; this instability could be developed in both low- and high-density plasma. The instability is generated in waves, which are nearly perpendicular to the magnetic field but possess a longitudinal component within the field. Experiments were carried out in which the 36-cm high and 2-cm radius plasma cylinder was heated to 2000°C by means of thermal ionization of the K vapors. The plasma density was highest at the center of the cylinder and reached a value close to 0 near the periphery. The measurements were carried out with magnetic fields ranging from 600 to 1600 oersted. It was found that within the whole density range oscillations with densities of about 5 to 9, 15 to 18, and 20 to 28 kiloherz were generated in the plasma. The oscillations did not seem to be connected with the electric layers at the boundary heated by W discs. In agreement with theoretical predictions, the oscillations were generated in the low-density (10^8 to 10^9 cm^{-3}) and high-density (10^{10} to 10^{11} cm^{-3}) plasma. The measured frequencies agreed with the calculated values; thus, at $T = 2000°C$ and $H = 1000$ oersted, a value of 5 kiloherz was obtained. The density and the radial density distribution seemed to be independent from the magnetic field. The observed effect corresponded to the "universal instability." (TTT)

24804 METHOD AND DEVICE FOR THE GENERATION OF STRONG MAGNETIC FIELDS FOR THE CONFINEMENT AND HEATING OF A PLASMA. Jiri George Linhart. German Patent 1,162,005. Jan. 30, 1964. Priority date July 5, 1960, Belgium.

The method described comprises the steps of generating a central plasma column within a cylindrical highly evacuated chamber, of introducing gas through a perforation in the cylinder jacket, and of subjecting this gas to a succession of electrical discharges that are coaxially arranged to the central plasma column, so that an ionized annular column is generated which moves inwardly and compresses the central plasma column. A device is described for carrying out this method. (Gmelin Inst.)

Shielding

24805 (UNC-5049) SYNTHESIS OF MINIMUM-WEIGHT PROTON SHIELDS. A. D. Krumbein, J. Celnik, F. R. Nakache, and E. S. Troubetzkoy (United Nuclear Corp. Development Div., White Plains, N. Y.). Feb. 25, 1963. Contract NAS 8-2658. 104p.

A shield synthesis technique originally developed for reactor shields was applied to proton shields. Both spherical and nonspherical shields were studied, and the effects of certain special constraints and of secondary neutrons were included in the analysis. The method indicates which materials should go into making up the minimum weight shield and what their order and thickness should be. The amount of weight saved is found to be a function of the inner radius of the shield and of the specific attenuation required. (auth)

24806 (XDC-61-1-149) MEASURED AND CALCULATED RADIATION LEVELS WITHIN AND BEHIND BERYLLIUM OXIDE. P. W. Schreiber and F. D. Kondras (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 15, 1960. Contracts AT(11-1)-171 and AF33(600)-38062. 51p.

Fast neutron dose rate measurements, thermal flux measurements, gamma dose rate measurements, and threshold foil measurements through a 21-inch slab array of beryllium oxide and behind various thicknesses of beryllium oxide are reported. The measurements were made in the GE-ANPD Source Plate Facility. The measured values were compared with calculated values. Point kernel computer programs and a multi-level diffusion program were used to make the calculations. (auth)

24807 ANALYSIS OF AN ELECTROSTATIC SHIELD FOR SPACE VEHICLES. Frank Henry Vogler (Lockheed-Georgia Co., Marietta, Ga.). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 872-8(May 1964).

Results of a preliminary feasibility study of the effectiveness of an electrostatic shield against an isotropic flux of charged particles are presented and discussed. Shield system efficiency for three different ranges of operating voltage and for various electrode sizes is examined. Weight of the structure required to support loads induced by the electrostatic charge on the electrodes is estimated. Shield effectiveness is defined as the fraction of the radiation removed for a given system weight; electrostatic shield performance is compared to that of a static shield composed of polyethylene. Performance of the static shield is superior in removing primary radiation for all cases examined. (auth)

24808 PROPAGATION OF ELECTROMAGNETIC WAVES THROUGH LAMINATED MEDIA. G. M. Filippov. Radiotekhn. i Elektron., 9: 547-51(Mar. 1964). (In Russian)

Propagation of electromagnetic waves through laminated media, described by electron density and distance along a metallic waveguide axis, was analyzed. (R.V.J.)

24809 METHOD FOR THE MANUFACTURE OF PLASTICS-LINED NEUTRON SHIELDS. Angel Alberto Blanco (to Imperial Chemical Industries Ltd.). German Patent 1,162,694. Feb. 9, 1964. Filed Dec. 30, 1959.

A method is described for the coating of neutron shields with plastics which comprises the steps of arranging a framework at a certain distance from the wall of the shield, of filling the gap between the walls and the framework with a plastic bulk material which contains an appreciable amount of hydrogen, and of filling up the interstitial spaces in the bulk material with a hydrogen containing liquid, for example a hardening agent. (Gmelin Inst.)

REACTOR TECHNOLOGY

General

Refer also to abstracts 23775 and 23776.

24810 (AEET/ROD/10) COMMISSIONING OF NUCLEAR REACTORS. V. Surya Rao (India. Atomic Energy Establishment, Trombay). 1963. 13p. (CONF-523-1)

From the IAEA Study Group Meeting on Operational Problems of Research Reactors and Their Use for Isotope Production and Activation Analysis, Manila, Dec. 1963.

Various phases of commissioning are reviewed, and criteria for planning are discussed. (R.E.U.)

24811 (ANL-6805) ELMOE: AN IBM-704 PROGRAM TREATING ELASTIC SCATTERING RESONANCES IN FAST REACTORS. A. L. Rago and H. H. Hummel (Argonne National Lab., Ill.). Jan. 1964. Contract W-31-109-eng-38. 68p.

The program ELMOE calculates the Fourier transform of the neutron flux for a mixture of moderators heavier than hydrogen, taking the moderator scattering law rigorously into account. For the flux calculations, the usual P_1 approximation and the "consistent" B_1 and P_1 approximations are available. The equations, sources of information for the cross section library, and operating instructions are given; and the treatment of narrow resonances is outlined. Input and output are also described. (D.C.W.)

24812 (ANL-6880) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, MARCH 1964. (Argonne National Lab., Ill.). Apr. 15, 1964. Contract W-31-109-eng-38. 86p.

Summaries are presented of developments in boiling water reactors, liquid-metal-cooled reactors, general reactor technology, advanced systems, and nuclear safety. Separate abstracts were prepared for each topic. (T.F.H.)

For abstracts of individual sections see: 23817, 24813, 24951, 24952, and 24953.

24813 (ANL-6880(p.49-67)) GENERAL REACTOR TECHNOLOGY. (Argonne National Lab., Ill.).

Summaries are presented of studies on: reactivity characteristics of the High Conversion Critical Experimental Facility; design of ionization chambers having sub-nsec rise times; development of ELMOE code for ZPR-III criticality studies; the Na void coefficient of reactivity in Na-cooled reactors; UC fabrication into pellets; PuC irradiation testing in TREAT; thermal properties of US; crystal structure of $U_3O_8-Gd_2O_3$ compacts; rendering potassium-aluminoborate glass radiation-resistant by Ce (and, unsuccessfully, Ag) additions; heat transfer studies on one-phase liquid coolants near the thermodynamic critical point; systematics of the surface tensions and viscosities of Freons; corrosion of Ni by F_2, HCl, and O_2 in N_2; preparation of UC; phase studies on LiCl−NaCl−$MgCl_2$ and LiCl−KCl−$MgCl_2$; measurements of densities of liquid KCl and Cd; and Pu and U separation from ceramic fuels by fluoride volatility process on alumina beds. (T.F.H)

24814 (CEA-R-2411) LA SECURITE PERIODE PENDANT LE DEMARRAGE DES PILES ATOMIQUES. (The Period Safety Trip During the Startup of Atomic Reactors). Jacques Furet (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). Mar. 1964. 28p.

The rapid startup of reactors is compatible with safety considerations only if the following criteria are observed: a high rate of energy liberation if the reactivity is ≤ 0; a low rate of energy liberation if the reactivity is ≥ 0. The study shows that during the conventional period safety excursion; logarithmic and difference amplifiers do not make it possible to conform to these criteria, because of the electron transient on the one hand and because of the neutron transient on the other. Fast start-up programs connected with other measurements are analyzed, as well as other electronic devices designed to limit rapid variations of the power. (auth)

24815 (MLM-1184) REACTOR FUELS AND MATERIALS DEVELOPMENT PLUTONIUM RESEARCH: 1963 ANNUAL REPORT. L. J. Wittenberg and G. R. Grove (Mound Lab., Miamisburg, Ohio). Dec. 31, 1963. Contract AT(33-1)-Gen-53. 39p.

Phase studies are carried out on Pu−Ce−Cu, Pu−Ce−Ni, Ce−Ni, Pu−Ce, Pu−Y, and crystals of B. The thermal properties of Pu−Ce−Co are measured in the solid and liquid states. The viscosities of Pu−Fe alloys are measured as functions of the Fe content from 0 to 13%. The viscosities of Pu−Ce−Co alloys are measured as functions of temperature. The density of liquid Pr is found at 937 to 1190°C. The emf's of Cd−Bi alloys are compared with that of pure Cd. The vapor pressure of Cd is measured at 522 to 735°C. The prepartion and properties of PuO_2 microspheres, PuO−ThO_2 microspheres, PuO_2-ZrO_2 microspheres, PuO_2-SiO_2 glasses, and PuO_2 single crystals are described. (T.F.H.)

24816 (NAA-SR-8888(Sect.IV)) REACTOR SAFETY. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). 47p.

The general objective of the program is to obtain information that will permit the design of safe nuclear reactors and the accurate assessment of their hazards. More specific objectives are to perform analytical and experimental studies for reactor concepts that will: (a) permit a more accurate and detailed evaluation of potential hazards associated with reactor operations; (b) indicate improvements in reactor design to reduce or eliminate potential hazards and to avoid possible major damage to the plant, even when no radiation hazard exists; and (c) suggest possible reductions in the cost of those portions of the reactor plant required primarily for safety considerations, if it is shown that the hazard is less severe than previously indicated. All experimental effort on organic projects was concluded in accordance with revised project schedules. The writing of topical reports was initiated to formally document accomplishments on these projects. The experimental work on pressure transients and flow stability was concluded with up-flow and down-flow pressure transient tests. The results are in satisfactory agreement with a basic analytical model relating pressure, flow, and void fraction. As the first published experimental measurements of the transient two-phase flow, and void generation, the results on this project are an outstanding contribution to the basic foundation for a reliable evaluation of loss-of-pressure accidents. More than 100 in-pile capsule experiments were conducted to investigate void formation mechanisms during organic reactor transients. None of the experiments gave any evidence of the existence of void formation contributions from radiolytic or pyrolytic gas mechanisms. The effectiveness of transient boiling as a heat transfer mechanism in organic coolant decreases markedly for exponential heating periods below about 35 msec. This corresponds to a similar transition in water at periods of less than about 10 msec in the same region where the effectiveness of void reactivity feedback on shutdown is essentially lost. Thus it is inferred that in metal-fueled organic reactors, vapor void formation will not be a significant factor in reactivity compensation for excursions with periods shorter than about 35 msec. The transient pressures generated during the initial stages of transient boiling in organic coolant were found to be very small. The results of one test of fuel melting in organic coolant indicate that there are no mechanisms of destructive pressure generation due to exothermic reactions, vapor explosions, or steam explosions. An important criterion was developed that predicts wall temperature at the onset of stable film boiling. This criterion involves a simple expression, which is only a function of the critical temperature. An important contribution derived from this program was the development of a strong experimental and analytical technology for modular experimental reactor kinetics mechanism studies. A high temperature working loop was constructed to generate and measure sodium boiling heat transfer and hydrodynamic data. The loop is capable of performing boiling-experiments at pressures between 1 and 15 psia (1200 to 1620°F) with inlet velocities at nominal full flows up to 10 fps. Flow is provided by a 200-psi, 2000-lb/hr electromagnetic pump. The use of high pressure results in stable flow during all boiling experiments. Heat transfer measurements are generated over a 2-in. long by $\frac{1}{4}$-in. OD molybdenum-clad graphite heater insulated with boron nitride. The maximum heat fluxes obtained are in excess of 1,000,000 Btu/hr-ft^2. Tests of the heater and pump resulted in a considerable quantity of new boiling heat transfer and burnout data. As the result, a new nondimensional correlation of critical heat flux in pool boiling was developed that is applicable to all liquids. A simple equation was developed to extend burnout prediction methods from pool boiling to forced convection subcooled boiling. This equation was used to estimate the burnout margin for the ASCR of at least 10. The project to examine the behavior of a prototype uranium carbide fuel rod when subjected to transient irradiation in the TREAT reactor was initiated. A preliminary analysis and evaluation was completed, which established the feasibility of utilizing an existing in-pile capsule design employed for UO_2 fuel experiments in TREAT, with minor modifications. The detail design of those modifications was completed and fabrication was initiated for the Phase-I experiments. A proposal for uranium carbide transient heating experiments in TREAT was completed and forwarded to ANL. The proposal contains a hazard summary, detailed planning of the Phase-I experiments, and the test schedule. A series of in-pile experiments were performed to measure the fission product retention of sodium. These experiments confirmed the concept that sodium effectively prevents the escape of fission products by the rapid refreezing of molten fuel and that a very high retention efficiency is thereby extant for iodine and nonvolatile fission product species. Arrangements were made to obtain sodium and cover gas samples for confirmatory information from the SRE. Out-of-pile experiments were planned to determine the parameters of fission product release and retention mechanisms. Some difficulties were experienced in achieving a sufficient inventory and material balance of iodine in in-pile capsules. Nine intermediate size (30 to 200 lb) sodium fires were completed in the study of the release of fission products and mechanisms of auto-extinction. These tests indicate appreciable retention of iodine because of the formation of relatively nonvolatile sodium iodate. No free iodine or iodide is released from a sodium fire. The total burning time and the total sodium burned are strongly dependent on the temperature of the bulk sodium during burning. Higher bulk temperatures require a thicker crust for extinction. In no case has a crust of >10 in. been required for auto-extinction of sodium fires was demonstrated in the test involving 3000 lb of sodium in a 5-ft diameter burn chamber. The chamber was heavily insulated; the bulk sodium temperature reached 1350°F; and the fire burned 26 hr. The fire was extinguished by a 10-in. crust of oxide. Some tests were run which indicate that auto-ignition of 1000°F sodium requires oxygen concentrations of >9%. Burning rates have limited-humidity dependence. The first edition of the reactor housing design manual entitled "Low Pressure Containment Buildings" was published. More than 500 copies were distributed for comment. Component model studies continued with a large number of pressure tests in the concrete model. Over a period of one year, many cracks appeared in panels and joints. The cracks are believed to be caused by the pressure tests that were performed on the structure, and on the lack of building expansion-joints. Epoxy paint reduced the leak rate of the concrete model to ~2 to 3%/day. These studies indicate the feasibility of using reinforced concrete for reactor building enclosures with leakage specifications <1%/day at pressures up to 1 psi. Initial work with prestressed concrete indicates that with properly designed joinery, painted interiors, and cylindrical geometry it may be possible to construct buildings with leakage specifications of 1%/day at 10 psi overpressure. Methods of sealing multiconductor cables and conduit seals were developed during the year. Economic studies were initiated. Although the costs evaluations are not yet complete, there are indications that the design pressure has a much greater effect on increasing building costs than does leakage improvement. All the major hardware and equipment for the measurement of Doppler coefficients were completed. The core designs and associated calculations for the measurements were completed. Measurements will be made in a variety of lattices as a self-checking feature on the validity of combined spectral and Doppler calculations. The first lattice was assembled which is very close to a 1/E neutron spectrum. The initial measurements, by activation, of the resonance integrals and Doppler coefficients in gold and uranium metal have begun, with the aim of establishing them as standards against which other materials can be measured. The measurements will cover a range of surface/mass ratios at three different temperatures. This will be followed by identical measurements in two lattices, which differ systematically from a 1/E neutron spectrum. In a second series of experiments, identical measurements will be made by use of a reactivity oscillator. The systematic differences in resonance integrals between the two methods will be identified. The final step in developing the method will utilize the extreme sensitivity of the oscillator method to investigate more subtle effects. A more generalized reactor kinetics code was developed for numerical solution of the space independent reactor kinetics equations. A computer program was developed to assist in the establishment of design parameters required for the siting of power reactors. The work on space-dependent kinetics has continued, with concentration on the development of models to evaluate the feasibility of the modulated neutron experiment. (auth)

24817 (NDA-14-134) HEAT TRANSFER EFFECTS IN MODERATE ACCIDENTS TO FAST REACTORS. R. L. Mela, H. G. Elrod, Jr., and H. Waldinger (Nuclear Development Corp. of America, White Plains, N. Y.). July 20, 1956. 28p.

A simplified analysis of the behavior during accidents of fast reactors having plate- or pin-type fuel elements is presented. Specific application was made to a reactor model based on the APDA reactor. The study extends an earlier analysis by Daane, who considered a one-point reactor with one group of delayed neutrons. Both analyses assume that reactivity is added at a constant rate. Daane's analysis was concerned with the initial stages of an accident, during which inertial restraint of the rapidly expanding fuel material is important but no significant heat transfer from the fuel elements to the coolant occurs. His study considered only the reactivity reduction caused by expansion of the elements themselves. The present analysis includes the effect of element-to-coolant heat transfer, thereby extending the time during which valid results can be obtained, and introducing a second mechansim of reactivity reduction, namely coolant expansion. The equations describing the behavior of the reactor were solved for reactivity insertion rates of 1$/second, 2$/second, and 5$/second. The reactor powers and fuel temperatures are compared with corresponding results obtained when heat transfer is not included in the analysis. (auth)

24818 (WAPD-T-1649) MONTE CARLO CALCULATIONS OF REACTOR EIGENVALUES. R. M. Cantwell (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Oct. 1963. Contract AT-11-1-GEN-14. 5p.

A two-dimensional matrix estimate of the Green's function for the reactor eigenvalue problem is obtained by dividing the multiplying regions of the reactor into nonequal mesh intervals. A computer program was written for the Philco 2000-212-2 to perform a Monte Carlo four-group diffusion theory eigenvalue calculation for a one-dimensional slab reactor with water reflector. (R.E.U.)

24819 NUCLEAR REACTOR. John C. Linsenmeyer (to American Radiator and Standard Sanitary Corp.). U. S. Patent 3,132,999. May 12, 1964. Filed Aug. 11, 1960.

A boiling reactor is designed for the production of superheated steam. In the reactor, water passing upward through the core is converted into saturated steam, which is then passed down through a set of tubes to produce superheated steam. Valves are provided so that the degree of superheat can be controlled. (D.L.C.)

Auxiliaries and Components

24820 (GNEC-337) DEVELOPMENT OF HYDRAULIC BALL (HY-BALL) CONTROL SYSTEM. Quarterly Progress Report No. 7, January–March 1964. (General Nuclear Engineering Corp., Dunedin, Fla.). Apr. 1, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(38-1)-207. 78p. (EURAEC-1024)

A physics analysis (including void-distribution and burnup effects) of the axial power distribution of a core with three axial zones of different enrichment fuels was completed. The beginning-of-life equilibrium steam void distribution was used for all stages of burnup for these lifetime calculations. Reasonably precise internal (within the Hy-Balls) heat generation rate calculations were run to provide firm data on which to base the final reference design of the Hy-Ball control system. The cooling conditions were defined for holding the Hy-Ball columns in the in-core position; these conditions are based on the expected maximum calculated internal heat generation rate. The Hy-Ball control system was examined for problems due to water hammer. This examination involved methods that accounted for effects due to valve closure times. The initial design development, and testing of columns for operation in intermediate positions was begun. Tests were run in the cold test loop to determine the cause of the abnormally slow scram of the ball-loaded vertical-tube-hopper Hy-Ball assembly which was used in the hot test loop Test No. 3-c. A new Hy-Ball assembly with a compact helical hopper was constructed and is now undergoing testing. This assembly, which is loaded with balls, differs from all assemblies which were previously tested in that all previous assemblies had vertical tube hoppers. Room temperature water leakage tests were run periodically on the three-way control valves. Testing of valve systems was started using the contaminated water test loop. Particular attention is being given to valve sticking due to crud buildup between moving parts. The reactor temperature series of tests designated No. 3-c and 4-c were successfully completed. Vertical tube hoppers were used for both the ball- and cylinder-loaded Hy-Ball column assemblies for Test No. 3-c. For Test No. 4-c, a compact (coiled helical tube) type of hopper was used with the ball-loaded assembly; the vertical tube hopper for the cylinder-loaded assembly was not changed. The hot test loop was modified and a special Hy-Ball assembly was constructed for the purpose of running tests to establish the magnitude of the effects due to steaming in the control system. (auth)

24821 (HW-75374) AN AUTOMATIC MONITOR FOR As^{76} CONCENTRATIONS IN REACTOR COOLING WATER. H. G. Rieck (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1963. Contract AT(45-1)-1350. 29p.

A system (described) was developed for monitoring ^{76}As concentrations in reactor cooling water. Gamma energy measurements are made on a sample which has been pretreated with cation exchange resin and decayed for 3 hr to reduce interference. Additional correction for isotope interference is applied during the counting step. A prototype monitor for ^{76}As was fabricated and tested. A sample is analyzed every hour, and the result is recorded in digital form. The minimum detection limit is 20 picocuries of ^{76}As per mililiter of reactor cooling water. The monitor has provided reliable operation with a minimum of service requirements. (auth)

24822 (PWAC-427) DESIGN AND DEVELOPMENT OF LCRE FISSION-COUNTER PREAMPLIFIER. G. F. Atkinson (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Mar. 31, 1964. Contract AT(30-1)-2789. 58p.

A four-tube preamplifier, capable of operating in a high-temperature, high-nuclear-radiation environment, was developed and tested for amplifying the pulse output of fission counters. The preamplifier uses ceramic electron tubes, deposited-carbon or metal-film resistors, glass-dielectric and porcelain-dielectric capacitors, ceramic-insert connectors, and soldered, terminal-board constru tion. Tested characteristics include a rise time of 40 nanoseconds, a linear output for negative input pulses to 25-millivolt amplitude, a gain of 25 when driving 200 feet of 50-ohm coaxial cable, a noise level at the output of 2.5 millivolts peak-to-peak, continuous operation at 250F, and a construction throughout of components and materials which are inert to nuclear radiation. (auth)

24823 (TID-7690(p.176-88)) WELDED-METAL-BELLOWS SHUTDOWN SEALS. R. W. Blair (Chicago Rawhide Mfg. Co.).

A static, nonrubbing seal, which acts more like a shut-off valve than the more common rubbing-contact dynamic seal, is described. These seals take over when the dynamic seals are nonoperative. They seal around the compressor shaft while the system is being evacuated of air before it is charged with helium. They also seal around the compressor shaft at shut-down and keep the helium in the system during repair or maintenance on the dynamic seals and bearings or other components. (M.J.T.)

24824 (TID-20613) STUDIES OF REACTOR CONTAINMENT STRUCTURES. Bi-Monthly Progress Report. F. Ahimaz, R. L. Chiapetta, C. J. Costantino, and M. A. Salmon (Illinois Inst. of Tech., Chicago. IIT Research Inst.). Apr. 1964. Contract AT(11-1)-578. 20p.

Analytic and experimental studies of the responses of thin-shell reactor containment vessels to internal pressure loadings are summarized. The effects of penetrations in the vessels are taken into account. Results obtained for vessels of mild steel are shown. (T.F.H.)

24825 DISCUSSION ON: PRESTRESSED CONCRETE PRESSURE VESSELS FOR NUCLEAR REACTORS. T. C. Waters and N. T. Barrett. J. Brit. Nucl. Energy Soc., 3: 119-48(Apr. 1964).

Comments on a paper which discussed the economics, mechanical properties, advantages and disadvantages of spherical and cylindrical prestressed concrete pressure vessels for use in nuclear reactors are presented. (L.B.S.)

24826 A SURVEY OF NUCLEAR REACTOR SAFETY CIRCUIT DEVELOPMENT. J. J. Smith. Nucl. Energy, 136-45(May 1964).

The general design and principles of shutdown circuits developed to date for British reactors are reviewed, and future design is considered. Safety interlock circuits are also briefly discussed. (D.C.W.)

24827 APPARATUS FOR PLOTTING A REACTOR THERMAL FLUX DIAGRAM. J. Vacher (CEA, Paris). p.451-6 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

A description is given of a device for plotting the flux diagram for thermal neutrons by means of semiconductor junction detectors made sensitive to neutrons by a layer of uranium oxide. These detectors are located at different points in cans slid into the different channels of the reactor. Each detector is linked to a very compact transistorized tunnel diode discriminator circuit that operates within the reactor and is of high sensitivity; it is also very stable with respect to temperature, and is not sensitive to radiation. The detectors in each can transmit information to a centralization unit along 2 coaxial cables. Each piece of information is identified by a time code. Two methods of extracting the information are described; one of them uses monostable discrimination circuits with instantaneous signal output as and when signals arrive; the other relies upon the bistable operation of the tunnel diode discrimination. In the latter method, each bistable element acts as a temporary memory unit and is addressed by the centralization system at regular intervals. (auth)

24828 DATA PROCESSING WITH NUMERICAL UNITS IN THE CONTROL OF NUCLEAR REACTORS. J. Megy, A. Chapelot, J. P. Satre, and J. Tranchant (CEA, Paris). p.547-53 of "Nuclear Electronics." Paris, ENEA, 1964. (In French)

The role of numerical units in the control of reactors is now becoming more widespread in France. A survey of the experience gained in this field up to the end of 1963 is presented. Initial operational results and present state of development of projects in hand are discussed. In the first phase, the role of the digital machines was limited to monitoring and recording of measurement. Computers and data processing machines are at present in use on an industrial scale at Marcoule (G 2-G 3) and Chinon (EDF 1), where they play an active part in the operation of these power reactors. In the same way, machines of this type are used with experimental reactors for recording measurements and analyzing experimental data. Examples are Pégase, Cabri, and César. Lastly, in power reactors under construction (EDF 2, EDF 3, EL 4) the present trend is to give the computers more complex functions such as: processing and monitoring of measurements of temperature, flow and pressure, and in the fields of burst slug detection and health physics, etc.; processing of signals; various functions of the programmed automation type, particularly connected with general reactor control; fuel handling may also be controlled by computer. The reasons for these developments are examined together with their bearing on the conduct of studies and other work during the construction of reactors and on reactor operation. (auth)

24829 FLUX MEASURING SYSTEM FOR A NUCLEAR REACTOR. (to Westinghouse Electric Corp.). British Patent 955,793. Apr. 22, 1964. Priority date Apr. 18, 1962, United States.

A reactor flux-mapping system, which uses flux-sensitive pellets instead of wires, is patented. The pellets are transferred from a storage hopper to a conduit system by gravity. Then they are blown by air or other fluid into a receptacle within the reactor core. After being activated, the pellets are blown out of the receptacle into another conduit system where the radioactivity of each pellet is measured separately. The pellets may be steel balls or other suitably shaped objects of flux-sensitive material. (M.P.G.)

24830 IMPROVEMENTS IN AND RELATING TO THE COOLING OF CONCRETE VESSELS. Charles Stewart Lowthian, Ronald Desmond Anthony, and Henry Miles Milling (to Nuclear Power Plant Co. Ltd. and AEI-John Thompson Nuclear Energy Co. Ltd.). British Patent 955,844. Apr. 22, 1964. Filed Mar. 3, 1961.

A method of cooling a concrete pressure vessel surrounding a reactor core is patented. The inner wall of the vessel and each hole through the vessel are lined with a layer of heat-conducting material. A series of ducts, through which cooling fluid is circulated, are attached to the layer of heat-conducting material. Thermal insulating material, which is also neutron absorbing, is placed between the heat-conducting layer and the reactor core. Two or more systems of cooling ducts in parallel are recommended to prevent hot spots if stoppage of a pipe occurs. (M.P.G.)

24831 IMPROVEMENTS IN NUCLEAR REACTORS. Martin Honess Kendon (to Rolls-Royce & Associates Ltd.).

British Patent 956,225. Apr. 22, 1964. Filed Dec. 24, 1962.

A method of circulating the pressurized liquid coolant in a reactor is patented. A small amount of the coolant at reduced pressure is used to drive a turbine, which drives the circulating pump for the coolant circuit. The coolant that drives the turbine is passed through a flash chamber to reduce its pressure and change its state to gas, and the gas is used to drive the turbine. The turbine may also drive an auxilliary pump to return the turbine-driving coolant to the primary circuit. (M.P.G.)

24832 IMPROVEMENTS IN OR RELATING TO GRABS. Almond Tinkler (to United Kingdom Atomic Energy Authority). British Patent 956,769. Apr. 29, 1964. Filed Dec. 2, 1959.

A device for removing elongated articles from a narrow channel, and especially for removing reactor fuel elements from coolant channels, is patented. The grab consists of an elongated tube open at one end so that it can be passed between the fuel element and the wall of the channel. A latching mechanism at the open end engages the bottom of the fuel element when the fuel element is inside the tube. If the fuel element has projections extending to the wall of the channel, the tube may be slotted so that it can pass around the projections. A lifting cable is attached to the closed end of the tube to lift the grab and fuel element out of the channel. The grab is especially suitable for the removal of damaged fuel elements. (M.P.G.)

24833 IMPROVEMENTS IN AND RELATING TO GAS-OPERATED GRABHEADS. John Freer (to English Electric Co. Ltd.). British Patent 956,861. Apr. 29, 1964. Filed July 17, 1959.

A remotely controlled gas-operated grabhead for moving slender objects through confined passages is patented. The invention is particularly applicable to moving objects into or out of a reactor pressure vessel. The jaw assembly of the grabhead is attached to the body portion in a way that permits the jaw assembly to move angularly out of axial alignment with the body portion. This enables the grabhead and a slender object gripped by the jaw assembly to pass around curves in a confined passage. (M.P.G.)

24834 RETARDING LINEAR MOVEMENT. (to Groupement Atomique Alsacienne Atlantique). British Patent 956,918. Apr. 29, 1964. Priority date June 15, 1961, France.

A pneumatic device for braking the fall of a moving object, specifically a reactor control rod, is patented. The control rod is connected to the piston of a pneumatic jack by a hollow tube that passes through the bottom of the jack cylinder. The tube has several radial holes near its connection to the control rod and several more holes, whose location nearer the top of the tube depends upon the distance through which the control rod falls. As the control rod falls, pressurized gas in the jack cylinder is forced into the hollow tube. Near the end of the fall, the hollow tube is no longer in the jack cylinder, and the gas is forced out through an opening near the base of the cylinder wall. This opening is connected to a nonreturn valve and a tank equipped with a calibrated exhaust orifice. A spring supports the piston at the bottom of the cylinder, and a groove in the cylinder wall allows the escape of gas trapped below the piston at the end of its fall. (M.P.G.)

24835 IMPROVEMENTS IN OR RELATING TO EXPANSION JOINTS FOR PRESSURISED FLUID CIRCUITS. Herbert Chilvers Knights (to United Kingdom Atomic Energy Authority). British Patent 957,343. May 6, 1964. Filed Aug. 9, 1961.

An expansion joint consisting of an inner flexible joint and a sealed sliding joint surrounding the inner joint is patented. The joint is designed for ducting systems conveying pressurized fluids at high temperatures. The inner joint is a bellows, the outer joint is sealed by sealing rings between the sliding parts, and the space between the joints is pressurized to reduce the pressure differential across the bellows. The joint is especially suitable in the ducting connecting the pressure vessel and heat exchanger of a gas-cooled reactor. Concentric bellows may be used for the flow of hot and cold coolants. An outer sheath concentric with the bellows would have a sealed sliding joint, and the annular space between the outer bellows and the sheath could be pressurized using a supply of fresh coolant. (M.P.G.)

24836 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Stanley Walsh (to United Kingdom Atomic Energy Authority). British Patent 957,623. May 6, 1964. Filed July 4, 1961.

A method is patented for providing early warning of a faulty sealing weld between the sheath and end cap of a reactor fuel element. A circumferential groove in the end cap is filled with 2 or more superimposed lengths of U strip, from which fission products will leak into the reactor coolant if a sealing fault develops. The strips may be plain, knurled, slotted, comb-like, perforated, or corrugated. By increasing the surface area of the uranium insert and the free space within the groove, the sensitivity of the detection method should be increased over that of similar inventions using different types of inserts. (M.P.G.)

24837 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. David William Williams, John George Edwards, and Arthur William Shilling (to United Kingdom Atomic Energy Authority). British Patent 957,624. May 6, 1964. Filed July 4, 1961.

A method is patented for providing early warning of a faulty sealing weld between the sheath and end cap of a reactor fuel element. A circumferential groove in the end cap is filled with a ring-shaped insert of sintered uranium dioxide before the end cap is inserted in the tubular sheath. If the seal between the sheath and end cap develops a fault, fission products from the uranium dioxide will escape into the coolant and be detected. For ease of assembly, the uranium dioxide may be formed in 2 or more segments. (M.P.G.)

24838 MODERATOR STRUCTURE FOR A NUCLEAR REACTOR. René Babule, Georges Lemesle, Roger Martin, and Pierre Rougge (to Commissariat à l'Energie Atomique). German Patent 1,162,004. Jan. 30, 1964. Priority date Oct. 18, 1958, France.

Heterogeneous reactors having stacked elements of solid moderator material formed with vertical ducts are discussed. The moderator structure includes a plurality of parallel adjacent prismatic bars of moderator material, longitudinal keyways formed in the bars so that the longitudinal midpoint of each keyway includes the longitudinal axis of the respective bar and keying means engaging the lateral walls of the keyways with a sliding fit to interconnect the bars laterally, radial clearance being provided between adjacent bars and between co-operating keying means and keyways to permit radial expansion of the bars without relative movement between the longitudinal axes of the bars. (Gmelin Inst.)

24839 METHOD AND MEANS FOR MONITORING GAS-COOLED NUCLEAR REACTORS. Ronald Hugh Campbell (to United Kingdom Atomic Energy Authority). German

Patent 1,162,007. Jan. 30, 1964. Priority date Apr. 27, 1959, Great Britain.

A monitoring apparatus is described by which a number of coolant samples can be tested concurrently for the presence of fission products. The apparatus comprises a bank of precipitation chambers, a precipitation electrode extending through the precipitation chambers, means for moving the electrode therethrough, a bank of monitors with which the electrode can be made to register after movement thereof out of register with the precipitation chambers, a pressure vessel enclosing the precipitation chambers, electrode, and monitors. The spacing of the precipitation chambers and the spacing of the monitors are similar, and the movement of the electrode is arranged so that a signal occurring at a monitor can be identified with a particular precipitation chamber. (Gmelin Inst.)

24840 METHOD FOR THE DETERMINATION OF THE NEUTRON FLUX DISTRIBUTION IN THE CORE OF A NUCLEAR REACTOR. Ronald Hugh Campbell (to United Kingdom Atomic Energy Authority). German Patent 1,162,008. Jan. 30, 1964. Priority date June 12, 1959, Great Britain.

The method comprises the steps of introducing a filament of fluid into a passage traversing the reactor core so that the filament becomes irradiated, removing the filament from the core, and measuring the distribution of activity along the filament. In another form of the method the filament is introduced into the passage at a constant velocity, it is removed from the passage at a different velocity, and the measured distribution of activity during the change in velocity is then differentiated to obtain a measure of flux distribution in the reactor core. (Gmelin Inst.)

24841 ELECTROMOTIVE DRIVE MECHANISM FOR CONTROL RODS IN NUCLEAR REACTORS. Herbert Alan Schwan and Harold Albert Thomas (General Dynamics Corp.). German Patent 1,166,945. Apr. 2, 1964. Priority date July 28, 1959, United States.

The drive mechanism for control rods suspended in nuclear reactors comprises a reversible, two-phase electric motor for propelling the rod in either desired direction to a desired adjusted position. The electric motor has means for temporarily adjusting the relation of the phases of the currents in the phase windings of the motor so as to cause the motor to rotate in either direction, and a biasing means for adjusting the phases of the currents in the windings so as to normally produce in the adjusted position a minor amount of motor torque sufficient to neutralize the force applied to the motor by the action of gravity on the control rod. (Gmelin Inst.)

24842 METHOD FOR THE CONTROL OF A NUCLEAR REACTOR. Cleve Richard Anderson (to U. S. Atomic Energy Commission). German Patent 1,168,577. Apr. 23, 1964. Priority date Apr. 14, 1959, United States.

A method is developed of operating a suspended-pellet, water-moderated nuclear reactor whereby a uniform suspension capable of maintaining a uniform neutron flux is obtained. The control of the reactor is achieved by varying the rate of flow of water which maintains the pellets in suspension. It was discovered that a bed of high-density particles can be uniformly fluidized by a flow of water upwardly therethrough provided the bed is operated under hindered-settling conditions. To obtain hindered-settling conditions the water inlet must be so located as to obtain a peaked velocity profile. One means for accomplishing this is to employ a conical flow distributor and admit the water at the center thereof. (Gmelin Inst.)

24843 NUCLEAR REACTORS. Everett Long and William Rodwell (to United Kingdom Atomic Energy Authority). U. S. Patent 3,132,998. May 12, 1964. Priority date Sept. 1, 1958, Great Britain.

A neutron shield for a reactor is designed with a shielding device for each fuel element channel. The shielding device comprises a rod with a plurality of helical fins; thus, neutrons are scattered while coolant flow is permitted through the shield. (D.L.C.)

Criticality Studies

24844 (ANL-6836) CYLINDRICAL LATTICE COLLISION PROBABILITY CODES, B692/RP. Edwin M. Pennington (Argonne National Lab., Ill.). Feb. 1964. Contract W-31-109-eng-38. 29p.

First-flight collision probabilities for a regular lattice of cylindrical fuel rods and moderator are calculated by means of the assumption that neutrons reaching the outer boundary of the unit cell are returned isotropically. The Fortran program written to calculate these collision probabilities is described, and comparisons are made with results of Fukai's exact method and other approximate methods. The treatment is then extended to lattices with cladding on the fuel, and a description is given of the corresponding three-region Fortran program. Collision probabilities calculated by the method presented are in rather good agreement with exact values. (auth)

24845 (APEX-638) EXPERIMENTAL RESULTS, P127 PRELIMINARY CRITICAL EXPERIMENT. D. H. Fraembs (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Aug. 5, 1960. Contracts AF33(600)-38062 and AT(11-1)-171. 26p.

The preliminary mockup (MOP-1 Moderating Oxide Pieces) of the P127 offset twin-engine design was constructed and operated in the SMR matrix facility. Reactivity, power, fission flux, and worths were measured. The results are presented and, in some cases, are compared with analytical predictions. (D.C.W.)

24846 (EUR-1618.e) THE FAST NEUTRON MULTIPLICATION FACTOR. L. Amyot (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). 1964. 20p. (CONF-469-4)

From Conference on Physics of Reactors, Milan, Nov.-Dec. 1963.

A general formulation is given for the fast neutron multiplication factor in which the spatial effects are expressed in terms of first collision probabilities and the energy dependence in terms of multigroup equations. The nonuniformity of the fission flux distribution, the effects of back-scattering from the moderator and rod-to-rod interaction, the heterogeneous composition of the fuel element, the photoneutron production in the moderator are all explicitly taken into account. (auth)

24847 (HW-79446) TWO DIMENSIONAL DYNAMIC ANALOG SIMULATION FOR A NUCLEAR REACTOR. C. Metelmann (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 1963. Contract AT(45-1)-1350. 28p.

The time dependent one-group diffusion equation, including delayed neutrons, is presented. A two-dimensional time dependent one-group difference equation is developed and is demonstrated using as an example the Hanford Test Reactor. A complete analog simulation diagram is given. (auth)

24848 (LAMS-2967) COUPLED CORE REACTORS. R. L. Seale (Los Alamos Scientific Lab., N. Mex.). Feb. 1964. Contract W-7405-eng-36. 39p.

The zero-power operation of an array of loosely coupled cores was analyzed to determine the steady state and kinetic behavior of such systems. Over the range of coupling-magnitude and coupling time lag considered, there are no coupling-induced resonances in the transfer functions. A large degree of flux tilting between the cores of the array can be encountered when reactivity values in the various cores of the array are allowed to vary. An attendant highly unsymmetric power distribution over the array can then result. (auth)

24849 (NP-13930(p.130)) STRAHLROHREXPERIMENTE MIT EINEM GETEILTEN CORE. (Beam Tube Experiments with a Divided Core). M. Tišljar and F. Woloch (Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf, Austria).

The effects of a central graphite moderator zone on the neutron and gamma radiation intensities in the ASTRA research reactor were investigated. The ratio φ_{th}/φ_f was increased and gamma dose rates were reduced. Changes, V, in the ratio $\varphi_{th}/\varphi_f + \varphi_{epith}$ between a moderator-divided and a corresponding undivided reactor were calculated. The comparison of these factors for beryllium and heavy water, with graphite as standard, gave $V_C : V_{Be} : V_{D_2O} = 1:1.39:1.32$. (M.C.G.)

24850 (NP-13963) RASCHET SPLAVYKH AVTOKOLEBATEL'NYKH REZHIMOV YADERNYKH REAKTOROV. (Calculation of Weak Self-Oscillatory Conditions in Nuclear Reactors). B. Z. Torlin (Akademiya Nauk S.S.S.R. Institut Teoreticheskoĭ i Eksperimental'noĭ Fiziki and U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoĭ Energii). 1964. 22p.

An approximate method of calculation of small-amplitude auto-oscillations of a reactor is given. An equation determining within the approximations made the possible states of auto-oscillations of a reactor, the amplitudes of the reactivity and the power, and their phase-difference is obtained. Some examples of application of the method are given. (auth)

24851 (ORNL-TM-570) THE REACTOR TRANSIENTS ACCOMPANYING PULSE SOURCE OPERATION AND STEP CHANGES OF REACTIVITY. C. A. Preskitt (Oak Ridge National Lab., Tenn.). Apr. 18, 1963. Contract [W-7405-eng-26]. 23p.

The method of over-all eigenfunctions developed by Foderaro and Garabedian is used to derive a method for calculating ascending and descending reactor transients due to the pulsed operation of a neutron source and the transient resulting from a step change of reactivity. The method is applicable to multiregion reactors of arbitrary composition, including reflected cores. The two-group approximation is used including epithermal fission, and the solution is obtained for one effective group of delayed neutron precursors. (auth)

24852 MEASUREMENTS OF BUCKLING AND RELATIVE REACTION RATES IN SOME PLUTONIUM–GRAPHITE ASSEMBLIES. D. H. Carter, W. G. Clarke, C. Hunt, J. Marshall, D. B. McCulloch, J. E. Sanders, and C. R. Symons (Atomic Energy Establishment, Winfrith, Dorset, Eng.). J. Nucl. Energy, Pt. A & B, 18: 105-24 (Mar. 1964). (AEEW-R-201)

The materials bucklings of a series of plutonium–aluminum alloy-fueled, graphite-moderated assemblies were measured, the carbon/plutonium ratio ranging from 14,520 to 2420. Fission ratios of ^{239}Pu, ^{235}U, and ^{233}U in the assemblies were obtained using small fission chambers. On one of the systems, experiments were extended up to a temperature of 370°C. The experimental data were compared with the predictions of a 43-group diffusion-theory code. Agreement between predicted and measured bucklings is good over the whole range of composition, within the limits of experimental error, which are equivalent to an uncertainty of about ±2 per cent in reactivity. The spectrum-sensitive ^{239}Pu/^{235}U fission ratios were 6 to 9 per cent higher than those calculated from the multigroup spectra. Comparison with further results from an assembly loaded with ^{235}U in similar configuration, leads to a ratio of the 2200 m/sec η-values of ^{239}Pu and ^{235}U of 1.02 ± 0.02. (auth)

24853 THERMAL REACTOR. Ira Bornstein (North American Aviation, Inc.). German Patent 1,166,391. Mar. 26, 1964. Filed June 5, 1958.

A method is given of compensating for the excess reactivity of a nuclear reactor during the samarium-149 buildup which comprises initially providing in the core of the reactor an amount of samarium equivalent to one to two times the equilibrium concentration of samarium-149 in the reactor. (Gmelin Inst.)

Fuels

Refer also to abstract 24372.

24854 (CEND-2863-211) THE DEVELOPMENT AND TESTING OF UO_2 FUEL SYSTEMS FOR WATER REACTOR APPLICATIONS. Progress Report, Period Ending, March 31, 1964. W. P. Chernock, C. E. Burdg, E. I. Veil, and G. Zuromsky (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Apr. 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-2863. 42p. (EURAEC-1056)

Four UO_2 thermal performance elements have been tested, and the results are reported. These results include determination of the effective thermal conductivity of the elements and the high-temperature thermal conductivity of UO_2. Collapse testing of 3.175 cm diameter tubing with t/R_0 (thickness/radius) values of 0.064 and 0.078 was initiated. Excellent correlation was obtained for tubes with t/R_0 of 0.064 for measured collapse pressures and those predicted by either the classical elastic collapse or the tangent modulus criteria. Correlations at the higher t/R_0 value, based on only two data points, were not good. Two-row, 17-tube subassemblies of type 347 stainless steel have been projection welded to provide tube-to-spacer wire welds of high quality and good dimensional control between centers of tubes (1.587 ± 0.008 cm) lying in a row. Further refinements are being made in cluster support fixtures to eliminate the present problem of lateral misalignment of adjacent rows of tubes prior to the fabrication of the full size 61-tube hexagonal cluster of type 347 stainless steel. (auth)

24855 (GEAP-3771-12) HIGH-PERFORMANCE UO_2 PROGRAM. Quarterly Progress Report No. 12, January-March 1964. B. Weidenbaum (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Apr. 15, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-189. 63p.

The testing of uranium dioxide fuel in the Pressurized Water Loop in the General Electric Test Reactor (GETR) during cycles 50, 51, and 52 is evaluated. Data and discussions are included on the routine chemistry parameters which were monitored and controlled. In addition, fission product release data are summarized for all previous defects. The similarity of the failures in both powder and pellet fuel with different fabrication histories, suggests that a lifetime limitation may exist for uranium dioxide fuel clad with Zircaloy-2 at the extreme thermal performance conditions experienced. A pressure transducer-gas bulb device was successfully operated for 2 hours at 2550°C with an internal operating pressure of 85 psia. This device used a rhenium gas bulb and exhibited a perfectly linear temperature response. The melting point of uranium dioxide was determined by the thermal arrest technique to be 2805°C. No difference was detected in the melting point between natural and enriched samples. The influence of initial grain size and density and fabrication history on grain growth in pellets was studied at three temperatures and varying lengths of time. (N.W.R.)

24856 (GEAP-4430) ACCURATE NUCLEAR FUEL BURNUP ANALYSES. Eighth Quarterly Progress Report, September 1963–November 1963. B. F. Rider, C. P. Ruiz, P. S. Luke, Jr., J. P. Peterson, Jr., and F. R. Smith (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Dec. 1, 1963. Contract AT(04-3)-189. 23p.

Progress is reported on the development of accurate methods for the determination of nuclear fuel burnup. The ion exchange behavior of aluminum, tungsten, and molybdenum in the analysis of stable fission product neodymium is studied. The behavior of heavy elements such as plutonium, americium, and curium in the neodymium separation on a D2EHP column is further investigated. The disassembly and analysis of the irradiation assemblies GEV-1 and GEV-2 is continuing. (N.W.R.)

24857 (GEST-2031) NAVY THERMIONIC DIODE PROGRAM. Semi-Annual Technical Summary Report. (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Dec. 21, 1963. Contract NObs-88621. 45p.

The design, fabrication, and processing of UO_2-fueled nuclear-thermionic diodes are summarized. The objective of the design study is the production of a long-lived, reliable nuclear-thermionic fuel element for use in U.S. Navy reactors. The testing is carried out using out-of-pile electrically heated thermionic diodes. (T.F.H.)

24858 (HW-80560F) PROGRAMMING. Monthly Report, January 1964. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 14, 1964. Contract AT(45-1)-1350. 32p.

The economics of using various combinations of U, Th, and Pu isotopes as nuclear fuels are outlined. A summary is presented of analyses of conversion of small production reactors to power reactors; seed-blanket reactors; Pu fuels, recycle, and conservation; and development of pertinent computer codes (JASON, MELAEGER, and ALTHAEA). Emphasis is placed throughout on Pu utilization. (T.F.H.)

24859 (TID-20593) A STUDY OF FUEL CYCLES IN ORGANIC-MODERATED NUCLEAR REACTORS (thesis). Stanley Louis Amberg (Massachusetts Inst. of Tech., Cambridge). Jan. 18, 1960. 128p.

A fuel-cycle analysis is presented for a 560-Mw (thermal), 150-Mwe, organic-moderated reactor under design by Atomics International. The IBM-704 reactor program FUELCYC was used to calculate fuel-cycle costs, burnups, and final concentrations of fuel nuclides. From the average energy yield (burnup) and the initial and final fuel compositions, the contribution of the fuel cycle to the cost of nuclear-electric power was evaluated. Costs were evaluated for a maximum burnup of 11,600 MWD/ton because radiation damage is expected to limit irradiation of the uranium alloy fuel to this burnup. A fuel with comparable heat transfer properties and a fabrication cost of about \$30/kg uranium, but with the capability of withstanding a maximum burnup of 26,000 MWD/ton would decrease the fuel cycle cost by about 70%. (D.C.W.)

24860 (UNC-5071) FUEL CYCLE DEVELOPMENT PROGRAM. Progress Report, October 1, 1962–June 30, 1963. E. Gordon and J. Crane (United Nuclear Corp. Development Div., White Plains, N. Y.). Sept. 30, 1963. Contract AT(30-1)-2374. 55p.

Work has been devoted to determination of the effects of carbon content and fabrication method on irradiation stability, thermal expansion, thermal conductivity, and hot hardness of uranium carbide. Uranium carbide containing 4.4 and 4.8 wt % carbon prepared by powder metallurgy and skull casting, and 5.2-wt %-carbon cast uranium carbide were evaluated. Thermal expansion measurements were completed. Nonstoichiometric materials showed slightly higher coefficients than UC, and cast material was slightly higher than equivalent sintered material. All conditions at 1000°C can be described by a coefficient of linear thermal expansion of $(11.5 \pm 0.3) \times 10^{-6}$ per °C. Thermal conductivity measurements for sintered and cast UC up to 1000°C were completed. The data show a coefficient decreasing slightly as a function of temperature to a minimum at 300°C and then increasing gradually to 1000°C. The sintered UC gave a coefficient of 0.22 watts/cm-°C at 1000°C; the coefficient of cast UC at 1000°C was 0.28. Hypostoichiometric and hyperstoichiometric compositions are tested. Hardness measurements of uranium carbide have been made at room temperature and at 500 and 600°C. At 600°C the cast 5.2 wt % carbon material showed the highest hardness. Two of three capsules irradiated in the MTR have been examined. The specimens in Capsule UNC-1-2 were sodium bonded to Nb–1 wt % Zr cladding and they received a burnup of 25,000 MWd/ton U. Fuel surface and centerline temperatures are believed to have been at least 780 and 1200°C, respectively. The specimens in Capsule UNC-1-3 were mechanically bonded to the clad. Burnup of these specimens was 15,500 MWd/ton U and fuel surface and centerline temperatures are believed to have been around 715 and 1115°C, respectively. The substoichiometric fuel showed the greatest fission gas release and swelling. The cast stoichiometric fuel was superior to the sintered UC except in the following case: the sintered UC mechanically bonded to the clad showed the smallest density decrease of all specimens irradiated. The cast 5.2 wt % carbon fuel was equivalent or superior to cast UC in most respects; however, this material, sodium bonded, lost all of its carbon in excess of UC stoichiometry during irradiation, and in general, showed a greater degree of fracturing. No catastrophic damage was observed and all capsule components performed satisfactorily. Specific cases of fuel-clad interaction are described. (auth)

24861 (WCAP-6060) UNIT CELL HOMOGENIZATION FOR REACTOR DEPLETION STUDIES. Harald A. Risti (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Apr. 1964. Contract AT(30-1)-3017. 147p.

Methods for the homogenization of the unit cell of the reactor fuel rod lattice were investigated in order to define procedures suitable for use in obtaining group diffusion parameters for use in multidimensional, few-group depletion analysis of reactor cores containing plutonium. Heterogeneous effects associated with fast fission, resonance capture and thermalization were considered, along with the influence of fuel rod and moderator temperature distribution in the unit cell. The major emphasis of the study was placed on the resonance energy range. (auth)

24862 (EURAEC-541) NUCLEAR VAPOTRON. Quarterly Reports 1-2, May–September 1962. (Compagnie Francaise Thomson-Houston, Paris and Societe Alsthom, Paris). Work Performed under United States–Euratom Joint Research and Development Program. 128p. (A translation)

The nuclear vapotron is a reactor fuel can having gear tooth-like projections extending longitudinally along its length. It is designed for use in boiling water reactors. Heat-transfer and flow-stability studies are described on simplified configurations of the vapotron geometry. Preliminary measurements are carried out on materials with high thermal conductivities, and then on materials having lower thermal conductivities (e.g., stainless steel) that are useful in reactors. Neutronic effects of the mass of the fuel can are ignored. (T.F.H.)

24863 (EURAEC-694) NUCLEAR VAPOTRON. Quarterly Report No. 3, October–December 1962. (Compagnie Francaise Thomson-Houston, Paris and Societe Alsthom, Paris). Work Performed under United States–Euratom Joint Research and Development Program. Contract 050-62-5 RDC. 196p. (A translation).

Parallelepiped samples are studied in the preliminary experiments because of their simplicity and the easy way in which they can be used in calculations and analog methods. Samples of other shapes are being experimented on. The influence of the front face or "cold face" has been checked on an isolated prismatic corrugation with triangular base. In the absence of this face, there is, for instance, no safety before slipping. Tests on an elementary scale have been made on copper samples, concerning the effect of interteeth channels, which bring hydrodynamical phenomena into play. These tests must lead to relations from which the dimensions of the corrugations can be defined. An empirical law derived from the results concerning the anodes of copper vapotron electron tubes agrees with the results obtained on the elementary structure that has the best characteristics. Within the scope of theoretical studies undertaken for arriving at a better comprehension of the thermal transfer involved in the vapotron process, some data obtained on a bulky silver sample are published that make it possible to plot the curve of local fluxes on a vertical surface that exhibits the vapotron effect. (auth)

24864 (EURAEC-770) NUCLEAR VAPOTRON. Quarterly Report No. 4 (Report No. 3), January–March, 1963. (Compagnie Francaise Thomson-Houston, Paris and Societe Alsthom, Paris). Work Performed under United States–Euratom Joint Research and Development Program. Contract 050-62-5RDC. 79p. (A translation).

The nuclear vapotron is a canning configuration for boiling-water-reactor fuel elements, having geartooth-like projections running longitudinally along the full length of the element. Experimental results on several simplified configurations (parallelepipeds, prisms, etc.) confirm the excellent heat-transfer and stability characteristics expected of the vapotron configuration. The experiments are carried out using Cu, Ag, and stainless steel. No account is taken of the effects of the mass of the vapotron can on the neutronic characteristics of the reactor in which the vapotron-canned fuel elements are used. (T.F.H.)

24865 (EURAEC-992) PLUTONIUM RECYCLING. Quarterly Report No. 13 (Suppl.). (France. Commissariat a l'Energie Atomique, Paris). 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 037-60-12 RDF. 14p. (A translation).

A summary is presented of studies of: natural U and Pu–U fuels; graphite thermal columns; critical parameters; and operations in the French assemblies Aquilon, Marius, and Minerve. (T.F.H.)

24866 HOW TOLL ENRICHMENT WILL REDUCE FUEL COSTS. David P. Herron (FMC Corp., Santa Clara, Calif.). Nucleonics, 22: No. 6, 62-3(June 1964).

Toll enrichment arrangements, in which a reactor operator supplies to a gaseous diffusion plant either natural U or reactor-discharge material partially depleted in ^{235}U, and receives in return UF_6 of the enrichment desired for reactor feed, are discussed. Two separate arrangements are outlined: these differ in the mode of operation of the gaseous diffusion plant. The effects of toll enrichment on fuel costs are calculated. (T.F.H.)

24867 A METHOD OF TEMPERATURE COMPUTATION IN MULTI-TUBE REACTOR FUEL ELEMENT. Arkadiusz Zmyslowski and Edmund Kmiotek (Inst. of Nuclear Research, Warsaw). Nukleonika, 9: 31-46(1964). (In Polish)

An analytical method for calculating the temperatures in the space within the walls of the fuel tube was derived. The system of linear differential equations holds for any number of tubing layers with a unidirectional and bidirectional flow of the coolant. Necessary assumptions were made as to the distribution of heat sources and the thermal coefficients of the medium. The analysis is limited to steady state conditions. Thus, equations were derived for the temperature distribution in the coolant and in the fuel. An illustrative numerical example is shown and special cases are appended; a rod element; a liquid moderator at constant temperature; and a solid moderator. (P.C.H.)

24868 PLUTONIUM ENRICHED URANIUM FUEL FOR NUCLEAR REACTORS. (to Atomic Energy of Canada Ltd.). British Patent 956,530. Apr. 29, 1964. Priority date July 28, 1961, Canada.

A reactor fuel consisting of a mixture of PuO_2 and UO_2 is patented. The mixture should contain at least 75% by weight of UO_2 and the remainder refractory PuO_2, which may be prepared by pyrolyzing PuO_2 at high temperatures. At least 80% of the PuO_2 should be in the size range of 44 to 840 μ. The fuel is prepared by uniformly mixing UO_2 with refractory PuO_2, compacting the mixture and then sintering it to a density of at least 90% of the theoretical density. (M.P.G.)

24869 IMPROVEMENTS IN AND RELATING TO NUCLEAR FUEL ELEMENT CASINGS. Marc Salesse and Jaques Andre Stohr (to Commissariat a l'Energie Atomique). British Patent 956,851. Apr. 29, 1964. Priority date Mar. 17, 1960, France.

A reactor fuel element casing with herring-bone-type helical fins is patented. The fins are arranged in transverse sets extending around the body of the casing, so that the plane between the fins of adjacent sets is perpendicular to the longitudinal axis of the casing. The fins in each set are parallel and oppositely handed to the fins in an adjacent set. The spacing between fins may vary within a set or between sets, and the angle of slant of the fins may vary between sets. (M.P.G.)

24870 IMPROVEMENTS IN AND RELATING TO STABILISING DEVICES FOR BODIES LOCATED IN A CHANNEL OR BORE. John Wilfred Hughes and John Morton (Nuclear Power Plant Co. Ltd. and AEI-John Thompson Nuclear Energy Co. Ltd.). British Patent 957,352. May 6, 1964. Filed Nov. 23, 1961.

A stabilizing device is patented for reactor fuel elements or other bodies located in channels through which fluid flows. The device is a wedge-shaped deflector, which forces the fuel element against the wall of the channel. The deflector is attached to the fuel element and extends partially around it and transversely to the fluid-flow direction. If the fuel element is finned, the deflector is attached to the tops of the fins. (M.P.G.)

24871 NUCLEAR REACTOR FUEL ELEMENT WITH ATTACHED THERMOCOUPLE. Bernard Turovlin (to General Dynamics Corp.). U. S. Patent 3,132,077. May 5, 1964. Filed Aug. 17, 1959.

The design of a fuel element with an attached thermocouple for determining the temperature at various selected points within the fuel element is presented. (C.E.S.)

24872 FUEL ELEMENTS FOR NUCLEAR REACTORS. Michael Carl Hartnell-Beavis (to General Electric Co. Ltd.). U. S. Patent 3,133,000. May 12, 1964. Priority date July 2, 1958, Great Britain.

A reactor fuel element is designed which has a low resistance to coolant flow and is particularly suited for use in high-pressure gas-cooled reactors operating at pressures on the order of 100 atmospheres. The fuel element comprises a carrier adapted for insertion in a reactor channel, at least one duct in the carrier, and a plurality of fuel members arranged across the duct at spaced intervals. The fuel members have their longitudinal axes arranged transversely to the duct axis, and their cross sections are of oval shape with the major dimension parallel to the duct axis. Several embodiments of the fuel element are described. (D.L.C.)

Power and Power-Breeder Reactors

24873 (ACNP-64517(Rev.1)) ZERO POWER EXPERIMENTS FOR SM-1 CORE III. F. G. Moote, L. D. Walthousen, J. L. Miles, T. M. Raby, and E. F. Clancy (Allis-Chalmers Mfg. Co. Atomic Energy Div., Bethesda Md.). Jan. 1964, Revised April 1964. Contract AT(30-1)-3106. 113p.

The SM-1 Core III is the first type-3 flat-plate core for use in the Army reactor program. Zero-power experiments were performed to confirm the core nuclear properties and prepare loading procedures. Reactivity measurements compared each element to a standard mockup element to confirm uniformity of fuel and boron loadings. The core was assembled by an inverse multiplication approach to criticality. Reactivity worth of special core components was measured. Control rod calibration curves were prepared for three individual rods and the banks of five and seven rods. Power distribution measurements were made by activation of fission foils. Computer calculations were made of power distribution and of reactivity changes with core burnup. Core reactivity was greater than expected from earlier mockup experiments, indicating that the effect of flux suppressors may be small. (auth)

24874 (ACNP-64529) LA CROSSE BOILING-WATER REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Technical Report No. 3. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Bethesda, Md.). Mar. 1964. 75p.

Progress made in the development of the La Crosse Boiling Water Reactor is reported. Information is included on: in-core flux monitoring system, failed-fuel location system, control-rod drive mechanism, steam separators, steam dryers, dynamic analysis, control circuits, reactor design, and coupling tests. (N.W.R.)

24875 (ACNP-64536) ELK RIVER REACTOR OPERATIONS ANALYSIS PROGRAM TOPICAL REPORT—FUEL LOADING FOR SECOND CORE. E. D. Kendrick, M. N. Audi, and C. Ho (Allis-Chalmers Mfg. Co. Atomic Energy Div., Bethesda, Md.). Apr. 1964. Contract AT(11-1)-1232. 30p.

An analysis was performed to determine the weight per cent of ^{235}U in thoria for the second core of the Elk River Reactor that would give the highest feasible fuel exposure within the shutdown margin requirements of the reactor. The selected loading was 4.4 wt % ^{235}U. The methods and calculational models used are described, and specific results are presented. The fuel assemblies for the second core are also briefly described. (D.C.W.)

24876 (APEX-142) INTERNAL FUSES FOR POWER REACTORS. T. W. Donaven and J. G. Stuart (General Electric Co. Aircraft Nuclear Propulsion Project, Cincinnati). [1953]. Contract AT(11-1)-171. 19p.

Some discussion is presented on the need for and theory of internal fuses for quickly shutting down reactors. Particular emphasis is placed on the type of fuse that uses the energy nuclear fission to trigger an auxiliary energy source which propels poison into the reactor. The similarity between this problem of propelling the poison into the reactor and a problem of ballistics leads to a division of the development of the fuse into the three following parts: trigger, primer, and propellant. The results of various experiments with shaped-charge explosive propellants are presented. (L.M.T.)

24877 (BAW-189) REACTOR PHYSICS STARTUP TEST RESULTS—INDIAN POINT REACTOR. R. M. Ball, M. L. Batch, J. C. Deddens, and J. P. Farrar (Babcock and Wilcox Co., Lynchburg, Va.). Mar. 1963. For Consolidated Edison Co. of New York, Inc. 77p.

The initial fuel loading and approach to criticality (achieved August 2, 1962) are briefly described, and the results of tests performed during initial operation are presented. The test program involved measurement of the power, pressure, boric acid, and temperature coefficients of reactivity; a rod group reactivity calibration; confirmation of stuck rod criteria; a xenon evaluation after shutdown from full power and equilibrium conditions; and instrumentation calibration and response measurements. (D.C.W.)

24878 (CONF-504-3) INITIAL OPERATION OF THE SODIUM GRAPHITE REACTOR AT THE HALLAM NUCLEAR POWER FACILITY. J. Denny Cochran (Consumers Public Power District, Hallam, Nebr.) and J. E. Owens (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). [1963]. Contracts [AT(11-1)-513 and AT(11-1)-Gen-8]. 26p.

From the American Power Conference 26th Annual Meeting, Chicago, Apr. 1964.

The testing program for the facility has been successfully completed up to full power operation at 250 Mw (thermal), and the plant has been supplying power. The plant is briefly described, together with personnel organization and training. Operating experience and the testing program are also reviewed, and the problems encountered are discussed. The testing and initial operation of the facility have demonstrated the safe, simple operation of the sodium-cooled graphite reactor. (D.C.W.)

24879 (CVNA-204) CVTR SIX-MONTHS OPERATING REPORT, OCTOBER 1, 1963–MARCH 31, 1964. (Carolinas Virginia Nuclear Power Associates, Inc., Parr, S. C.). 48p.

On December 16, 1963, the first electrical energy was generated. Low power physics tests were continued and special tests involving the approach to power were performed. A sustained power run of several days with no major problems proved out component reliability. Operation of the reactor was curtailed by necessary maintenance. Three areas requiring considerable effort were the replacement of header cavity insulation, increased friction of rod drives when cold, and multiple revisions in fuel handling tools and equipment. Plant chemistry results generally fell within operating limits. Fluoride and chloride contamination of header cavity drains is slowly improving. Minor heavy water degradation continues but it is expected that continuous operation and fewer shutdowns will decrease the degradation rate. Plant and environmental radiation surveys generally indicated expected results, with some increase in activity noted with power operation. Air activity in the vapor container indicated a higher reading with power operation than expected. Analysis indicated it was principally argon-41. (auth)

24880 (DLCS-3570501) REACTOR PLANT CONTAINER INTEGRITY TEST (BUTTERFLY VALVE HYDRAULIC SYSTEM TEST). CORE 1, SEED 4. Test Evaluation. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 22, 1964. Second issue, May 6, 1964. Contract AT(11-1)-292. 20p.

The purpose of the plant container integrity test was to determine the effects that low accumulator nitrogen pressure, low accumulator hydraulic pressure, and the adjustment of certain flow regulating valves have on butterfly valve closure time. The results of this test indicated that butterfly valve closure time is shorter with maximum specified accumulator nitrogen pressure (250 psig) and with maximum accumulator hydraulic pressure (1250 psig). However, even under the most favorable test conditions, butterfly valve closure time exceeded the specified 2 seconds by approximately 0.3 second. The performance of the system during the test led to an investigation, which revealed a piping error. This error involved the reversal of the pilot lines to some pilot operated check valves. This error had made the butterfly valve hydraulic system incapable of emergency operation in cases where electrical power to the hydraulic pumps failed and make-up accumulator header pressure decayed to a point where it was necessary to use the drive accumulators to close the butterfly valves. The piping was corrected to conform to design drawings. (auth)

24881 (DLCS-4140301) REACTOR PLANT COOLDOWN AND TEMPERATURE CONTROL SYSTEM PERFORMANCE (COOLDOWN OF THREE OR FOUR COOLANT LOOPS). Test Evaluation. (Duquesne Light Co., Shippingport, Penna.). First issue, Mar. 12, 1964. Contract AT(11-1)-292. 12p.

The purpose of this test was to investigate the performance of the Cooldown System while cooling three or four reactor coolant loops and to determine if an air operated valve could satisfactorily perform its design requirement of maintaining the proper hotwell level in the cooldown heat exchanger. The reactor coolant system was cooled down from 500°F using this system; however, the performance of the system was unacceptable between 500 and 360°F. In this temperature range, either the condensate outlet temperature limitation was violated or river water boiling occurred. Below 360°F, the performance of the Cooldown System was acceptable. The air operated valve satisfactorily performed its design requirement of maintaining the proper hotwell level. (auth)

24882 (DP-905) HEAVY WATER MODERATED POWER REACTORS. Progress Report, March–April 1964. R. R. Hood, comp. (Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.). May 1964. Contract AT(07-2)-1. 36p.

Various mechanical problems prevented nuclear operation of the Heavy Water Components Test Reactor (HWCTR) during March and April 1964. Fabrication development was initiated on a set of uranium oxide driver tubes for the HWCTR. These tubes will operate at conditions of interest for D_2O-cooled power reactors and will increase substantially the utilization of the HWCTR as a fuel test reactor. A series of physics experiments on D_2O-moderated mixed lattices was conducted as a test of calculational methods. An equation for prediction of heat transfer burnout for flow of subcooled water in annuli was developed on the basis of burnout experiments. A preliminary analysis indicates that it is technically feasible to substitute liquid H_2O for liquid D_2O coolant in D_2O-moderated power reactors, but the economic gain may be marginal. (auth)

24883 (EURAEC-963) HEAT TRANSFER AND STABILITY STUDIES IN BOILING WATER REACTORS. Quarterly Progress Report No. 12, October 1, 1963–January 1, 1964. (Eindhoven, Netherlands. Technische Hogeschool). Work Performed under United States–Euratom Joint Research and Development Program. 34p. (WW016-R56)

Thermal-hydraulic tests on boiling-water loops are summarized. Steady-state and dynamic conditions are represented in the tests. (T.F.H.)

24884 (GEAP-4419) NUCLEAR SUPERHEAT PROJECT. Quarterly Report No. 17, August–October 1963. W. L. Fiock (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Nov. 15, 1963. Contract AT(04-3)-189. 113p.

Information is reviewed on the development and testing of nuclear-superheater fuel elements in the VBWR; operation and coolant chemistry of E-SADE loop; construction, testing, and measurement of control rod and fuel reactivity worths in Mixed Spectrum Critical Assembly; determination of SiO_2 and chlorides in coolant water of VBWR; welding parameters of Incoloy 800 and 304 stainless steel; and corrosion and performance of various alloys in nuclear-superheater environments. (T.F.H.)

24885 (GEAP-4488) HIGH POWER DENSITY DEVELOPMENT PROJECT. Fifteenth Quarterly Progress Report, October–December 1963. R. L. Holladay, comp. (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Jan. 1, 1964. Contract AT(04-3)-361. 92p.

All fuel irradiations in Task IA and IB were terminated with the final shutdown of the VBWR. Data on the irradiations are presented. Fuel assemblies will now be tested in the Big Rock Point Power Reactor. Stability tests for the Big Rock Point Power Reactor concerning core performance, control rod oscillator, pressure transient, and flow conditions were completed. Power distribution calculations were performed for the proposed 84-bundle, 75 Mw(e) core and for the high power density (60 kw/l) 41-bundle core. The results show that operation under the proposed conditions is feasible. The Big Rock Point Power Reactor core was increased to 74 bundles and is operating with eight developmental fuel assemblies among the core complement. (N.W.R.)

24886 (GEAP-4565) NUCLEAR SUPERHEAT PROJECT. Quarterly Report No. 18, November 1963–January 1964. (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Feb. 15, 1964. Contract AT(04-3)-189. 92p.

Information is presented and reviewed on: development and radiation-testing of nuclear superheater fuel elements; determination of chlorides and silica in VBWR coolant; determination of radioiodines in E-SADE and VBWR; operations of E-SADE in-pile loop; corrosion of alloys by reactor coolant water; the performance of selected alloys in the nuclear-superheater environment; and the startup and operations of the Mixed Spectrum Critical Assembly. (T.F.H.)

24887 (HW-80921) ANNUNCIATOR FOR A REACTOR AUTOMATIC CONTROLLER. E. M. Sheen and C. A. Ratcliffe (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1964. Contract AT(45-1)-1350. 11p.

A reliable solid state annunciator was developed for direct application with the Hanford Plutonium Recycle Test Reactor automatic controller. The annunciator provides four decades of audio pulse frequency response for controller output deviations of ±0.5 v and is capable of withstanding the full controller output level of ±10 v without loading the output more than ±0.5 μa. The high input impedance is accomplished with a solid state operational amplifier that drives circuits including a chopper, a-c amplifiers, rectifiers, voltage controlled oscillators, and a speaker driving amplifier. The complete system operates from a simple power supply. (auth)

24888 (HW-SA-3507) WATER–GRAPHITE RELATIONSHIPS AT CONSTANT MODERATION IN A HETEROGENEOUS LATTICE (thesis). G. F. Bailey (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 29, 1964. Contract [AT(45-1)-1350]. 76p.

A graphite-moderated pressure tube power reactor utilizing pressurized water as its coolant is considered. It is shown that a rather wide range of water and graphite can be used to achieve desired values of particular parameters. Since these parameters are dependent upon the moderator-to-fuel ratio, the various combinations of water and graphite result in constant moderation. It is proposed that the proper selection of water-to-uranium and graphite-to-uranium ratios will give a reactor that is optimum from both engineering and physics considerations. (C.E.S.)

24889 (LAMS-3069) QUARTERLY STATUS REPORT ON ULTRA HIGH TEMPERATURE REACTOR EXPERIMENT (UHTREX) FOR PERIOD ENDING MARCH 20, 1964. (Los Alamos Scientific Lab., N. Mex.). Apr. 1964. Contract W-7405-eng-36. 20p.

A summary is presented of the construction and testing of the components, systems, and facilities of the Los Alamos Turret Reactor. (T.F.H.)

24890 (MND-M-3088 & Add.1) METALLURGICAL EXAMINATION OF A PM-1 CONTROL ROD DRIVE SYSTEM PRESSURE THIMBLE. (Martin-Marietta Corp. Aerospace Div., Baltimore). Oct. 2, 1963. Includes Addendum 1. Dec. 12, 1963. Contract AT(30-1)-3290. 85p.

A metallurgical examination was made of one control rod drive mechanism armature and scram spring housing (pressure thimble) removed from the PM-1 Nuclear Power Plant. The corrosion product on the thimble consisted principally of Fe_3O_4. Pitting occurred under the corrosion product, principally along the edges of the encrustation. X-rays did not show cracks or gross defects. A gamma energy spectrum of the corrosion product showed a normal concentration of activated corrosion products. Pit depths ranged from $^1/_2$ to $1^1/_2$ mils. Corrosion products could be removed from pits by ultrasonic cleaning. No intergranular corrosion was detected on metallographic samples or by dye penetrant. Hand grinding to remove the pits was found to be feasible. A hydrostatic burst test was carried out on a section of the armature housing to remove pitting corrosion. The test section did not fail at an internal pressure of 9500 psi, which exceeds the hydrostatic test requirements of the PM-1 plant by a factor of 2.8. (M.C.G.)

24891 (NAA-SR-8888(Sect.I)) ADVANCED SODIUM COOLED REACTORS. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). 151p.

The objective of the Sodium Reactor Experiment Program is to operate the SRE safely at maximum allowable power and temperature with a use factor of 90% or greater. To accomplish this objective, support efforts of physics analysis and measurement are necessary; plant maintenance and surveillance contribute to the overall goal. The operation of the plant must furnish experimental information, confirm theoretical work, and indicate necessary developmental work through actual reactor operation experience. Additional objectives of this program are the design and fabrication of necessary reactor fuel loadings for continued meaningful operation. During the fiscal year, the reactor was in operation 190 days, 98 of which were at a power level of 10 Mw(t) or greater. By the end of the fiscal year, the cumulative energy extraction from the 2nd core reached 2025 Mwd; electricity production totaled 8,531,000 kwh. The reactor operated normally except for temperature oscillations, loss of the main and auxiliary primary pumps shaft seals, and the period spikes caused by gas bubbles and instrumentation. This sustained operation during the second half of the fiscal year considerably increased the irradiation of Core II fuel. The reactor was operated at 14 Mw prior to the end of the fiscal year. Temperature oscillations were observed in many of the fuel clusters with amplitudes as large as 50°C peak-to-peak. Extensive experimental measurements and analysis were performed in order to permit elimination of any oscillations that exceed the allowable limit imposed on the basis of stress analysis determinations. The amplitude of the oscillations was found to depend on the fuel temperature. Two different frequency ranges were observed, one between 0.1 and 0.5 cps, and the other from 0.2 to 0.5 cps; some clusters oscillated simultaneously in both modes. The oscillations are apparently associated with the individual fuel cluster rather than the process channel. In an attempt to eliminate the oscillations, the inner wire wrap was removed from three fuel clusters. These tests were inconclusive. A second attempt to eliminate the oscillations was made by adding springs to the strainer baskets on the bottom of the cluster to prevent the element from swinging in the channel. This modification had no significant effect other than making the oscillations more sinusoidal. The reactor did not achieve 20 Mw(t) operation by the end of the fiscal year as planned. Temperature oscillations in the fuel channels prevented the attainment of this goal. At present, the temperature oscillations are the main problem facing full-power SRE operation; satisfactory correction of this condition will substantially improve SRE operation. The objective of the large SGR program is to provide, in Fiscal Year 1964, the technical information with which construction of a large SGR can be undertaken with confidence. The design bases for the large SGR will depart substantially from those for the SRE and HNPF, particularly in higher operating temperature and increased specific power. These changes and the increase in power level are required to make the SGR competitive with other energy sources. The changes impose more stringent requirements on the reactor core structure, fuel elements, fuel handling machine, and control rods. Development work on these specific components, together with expanded effort on UC fuel and continuation of work in the more general ASCR program on reactor physics, sodium components, and reactor safety, is expected to meet the objectives of this program. In the development of UC fuel, out-of-pile compatibility experiments indicate that hypostoichiometric fuel, sodium bonded to Type 304 stainless steel, will be satisfactory for use in the next large SGR. The irradiation program yielded data from only two capsules. Several other capsules were not examined in the hot cell, because of the high cost of such examinations, because they contained fuel material other than hypo-UC, or because they had reached only a limited burnup. A considerable effort was expended during the year in redesign of capsules to improve the chances of thermocouple and cladding survival in the test reactors, and it is expected that the survival rate will improve substantially in the new capsule series. A total of 11 capsules was designed and fabricated during the year and more are in assembly. Three capsules were inserted into GETR and MTR, and one UC element in the SRE; four more capsules will be inserted in MTR in July. In summary, the irradiation program is now progressing well after a slow start early in the year. Increased emphasis was put on the effects of the radiation environment at SGR conditions on the stainless steel cladding. Cladding questions were somewhat neglected in the past in favor of emphasis on the UC fuel material. Good progress was made on development of the calandria core, although structural testing is behind schedule by several months. Possible structural difficulties that arose during structural analysis of the calandria were in general resolved or alleviated by modifications in design; the design changes postponed testing. In many areas, the redesign has also resulted in simplifications so that somewhat less testing will be required. Nevertheless, development progress on the calandria is the pace-setting item in the reactor components program. Emphasis in the work on control rods was shifted from the wet, sodium-immersed rod to a dry HNPF type when development of engineering data on materials in sodium logged and a design study indicated feasibility of using the dry rod in the reference core. The dry-rod work is progressing very well, by use of hardware which was fabricated for Hallam control rod development. Work on the wet rod is restricted by budget limitations to operation of two materials testing pots. Further increase in specific power for future SGR's will require additional effort on the wet rod. Fuel handling machine development progressed so rapidly early in the year that the work was de-emphasized to some extent in favor of more effort in other areas. The work progressed through design and procurement of most of the components of a one-barrel mockup of the handling machine, which will be assembled and tested in Fiscal Year 1964. Good progress was made in all areas of the large SGR program with the exception of calandria development. Schedule slippage on this item will require more effort in Fiscal Year 1964 than was originally planned in order to meet the objectives of the program. The general objective of the ASGR program is the production of economically conpetitive power from sodium cooled reactors. To accomplish this objective, the advanced development phase of the ASCR program investigates areas in sodium technology, fuels and materials, sodium reactor safety, and physics. Sodium heat transfer and reactor components are developed and tested to reduce costs, improve reliability, and increase the confidence level. Necessary research and development is provided to support advances in the SCR field. During the course of this fiscal year, several projects made significant advances either in construction of needed facilities (SCTI, Carbon-In-Sodium Analysis, and Two-Phase Sodium Heat Transfer); development of advanced techniques (Improved Physics Methods, Isotopic Dilution, Analysis of C in Na, High Flux Heaters, and High Temperature Strain Measurements); or accumulation of needed, fundamental data (UC Critical Experiments, Radioactive from released Sodium Fires, Shell-Side Heat Transfer, Bellows Life Tests, Cold Traps, Pressure Indicators, Strain Fatigue at High Temperature, and Waterside Stress Corrosion). Two new projects were initiated; Supercritical, Sodium-heated Modular Steam Generators and UC-TREAT experiments. Several projects were deferred in preference to short-range goals related to the 500-Mw(e) Sodium Graphite Reactor. Longer-ranged projects thus deferred fall in two categories; improved fuels, materials, and processes (High Strength Clad Materials, UC process SRE Core II Examination and Improvement, Paste Fuels), and general knowledge and techniques (High-Temperature Stress Fatigue, High-Temperature Strain Measurements, Waterside Stress Corrosion, Shell-Side and Tube-Side Heat Transfer, and Sodium Component Development). Some projects were terminated either because the program was completed (Helical-Rotor Sodium Pump), or the approach proved unfruitful or untimely (3Z1 High Strength Clad, Examination of SRE Core II, and Mechanisms for Sodium to Steam Generator Failure). Particular emphasis was and will be on support of the development of the large SGR plant, to improve the understanding of sodium reactor safety, and to test sodium components as required. (auth)

24892 (NAA-SR-8888(Sect.II)) HALLAM NUCLEAR POWER FACILITY. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). 30p.

The objective of the HNPF fuel surveillance program was to evaluate the performance of fuel elements in the Hallam reactor. Equipment, methods, and procedures are given for pre- and post-irradiation examinations of fuel elements. Analysis of operating data pertinent to the fuel element evaluation is correlated. The program in FY 1963 consisted of four projects: (a) U–10% Mo Fuel Surveillance and Examination, (b) Maintenance Cell Equipment Development, (c) Irradiated Fuel Rod Shipping Cask, and (d) Preirradiation Measurements on 10 UC Fuel Elements. The primary effort was placed on support of HNPF Core-I U–10% Mo fuel examination. A program was developed that comprised both nondestructive and destructive examinations at the HNPF maintenance cell and the Component Development Hot-Cell, respectively. Methods of nondestructive testing were analyzed and specific techniques are being developed on an experimental basis. Equipment to perform these tests was designed and is being fabricated. Methods of disassembly of irradiated fuel elements, and of handling the entire fuel operations cycle within the HNPF maintenance cell were developed. Procedures for these operations are being prepared. A small shipping cask to handle four fuel rods or one entire fuel element was designed and is in initial stages of procurement. Preirradiation measurements were made on 19 UC fuel rod components within the 10 UC elements planned for irradiation in early FY 1964. As a result of the analysis of the U–10% Mo fuel performance capability under Project 4938, which showed a peak burnup capability of 4000 ± 2000 Mwd/T, this fuel examination and surveillance program was rescheduled to meet the new requirements. The program was initiated in March 1963. The schedule for completion of the tasks to support the U–10% Mo fuel examination is very tight. The cask completion by September 1963 will be difficult. Because the requirements of the first maintenance-cell nondestructive examinations at 1500 Mwd/T peak exposure are scheduled for September 1963, the completion of procurement, installation, and test and checkout of the maintenance cell equipment and procedures will require expediting of all tasks. The responsibilities between AI and CPPD with regard to training of personnel and for maintenance cell operations need to be determined. The examination of the U–10% Mo four-rod element now being irradiated in SRE, generally under HNPF conditions, should be considered for destructive examination with respect to its potential contribution to Core-I burnup limitations. This latter task is not a part of the present FY 1964 program. Substantial progress was made on each subaccount in this program. The schedule will continue to be the factor for determination of the level of effort relative to the nondestructive equipment fabrication and procedure development. There are no major technical problems to be resolved pending experimental verification of the equipment now in fabrication. (auth)

24893 (NAA-SR-8888(Sect.III)) ADVANCED ORGANIC MODERATED REACTOR. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). 46p.

The overall objective of this program is the achievement of economic power generation from a nuclear reactor moderated and/or cooled by an organic liquid. The immediate goals can be summarized as follows: (a) to demonstrate the feasibility of the concept; (b) to study the performance of organic moderator coolants, and obtain reactor operating experience under conditions of temperature and radiation identical with those expected to prevail in full-scale power reactors of this type; and (c) to develop improved coolants, components, and systems for use in full-scale organic-moderated and -cooled nuclear power plants. The FY 1963 effort on the organic-moderated and -cooled reactor program was severely affected by a major funding reduction in September 1962, which was shortly followed by the AEC's decision in December 1962 to terminate the program by the end of the fiscal year. As a result, progress on the Advanced OMR Research and Development Program was less effective than would have been expected under more normal circumstances. The operation of the third core of the OMRE was not directly affected. Termination of OMRE operation, however, eliminated the possibility of establishing the individual contributions of the various methods of coolant treatment to the control of the purity of the coolant. The operation of the OMRE was in general highly successful. Power operation of the reactor was initiated late in July 1962. The reactor operated only intermittently through August and September 1962, because of relatively frequent plugging and consequent need for replacement of a 40-μ full-flow strainer. This strainer was replaced with a 250-μ unit at the end of September 1962. With the exception of a three week fuel handling shutdown in January-February 1963, the operation proved very steady, with the reactor operating at power more than 90% of the time until its final shutdown on April 3, 1963. The power level of the reactor was initially maintained at 4.5 Mw(t), then raised to 5.0 Mw(t) in the middle of November 1962. Coolant purity control was maintained by means of distillation, adsorption on a bed of Attapulgus Clay, and filtration through two systems of 3-μ glass-spool, and 5-μ sintered stainless-steel filters. Contact of the hot coolant with the atmosphere was minimized, and the coolant was extensively purified prior to power operation following any exposure to air. At the time of the final shutdown, the third core of the OMRE had accumulated a total exposure of 1104 Mwd, including 282 Mwd on Core III-A, 613 Mwd on Core III-B, and 209 Mwd on Core III-C. The estimated peak burnup on the individual test elements amounted to 8,500, 12,000, 7,600, and 10,000 Mwd/MTU on the four APM-clad UO_2 fuel elements, and 5,600 Mwd/MTU on each of the two aluminum-clad U–Mo fuel elements. The thermal behavior of all these test elements was excellent, with the exception of only one minor anomaly attributed to distortion of fuel pins on one of the APM-UO_2 fuel elements. Following the shutdown, all the fuel elements, all control rods, and the neutron source were removed from the core, and the coolant was drained from the system. The installation is presently in the final stages of deactivation. Initial results from the hot-cell examination of OMRE test elements showed both APM-clad UO_2 test elements 4-1 and 4-2, with estimated peak burnup of 8500 and 12,000 Mwd/MTU, respectively, to be very clean, with only a very thin dark film deposited at the surface of the cladding and no obstruction to coolant flow; this confirmed the previous indications of excellent in-core thermal performance of these elements. Examination of the high-temperature cermet driver element removed in January 1962 showed significant distortion of the fuel plates, localized deposition of large clinkers, and some fuel plate cracks under the clinkers. Indications are that the fuel plates on this element were not free to expand as intended in the design, and therefore distorted, thus causing flow restrictions, hot spots, and consequent clinker formation and fuel plate cracking. The operation of the third core of the OMRE can be considered a major step in the development of the organic reactor concept, both from the point of view of minimization of fouling and from the point of view of development of APM-clad UO_2 fuel element technology (there was no failure in any one of the 98 experimental fuel pins irradiated). While satisfactorily demonstrating the feasibility of the concept under OMRE operating and coolant treatment conditions, it was terminated before detailed information on the effect of individual operating parameters and coolant processing treatments could be determined. On the Advanced OMR Program, major progress was made in two areas: in coolant chemistry, where initial development was carried out on a new fouling index, the Membrane Stain Test light absorbance value, which proved to be considerably more sensitive than the previously used ash content and in the PCFT measurements. Additional development, however, will be required before the meaning of the results of the latter test is fully understood. Techniques were also perfected for both water and carbonyl oxygen analysis of the coolant. The fuel development work was concentrated on the development of APM cladding. Significant progress was made in alloy and billet characterization, determination of mechanical properties, extrusion, and in end closure welding techniques. Although additional development of this material is still required, the successful irradiation of 98 APM-clad fuel pins in the OMRE is a testimony to the advanced state of APM technology. (auth)

24894 (NAA-SR-Memo-7743) HAZARD ANALYSIS OF A SODIUM-WATER REACTION IN AN SRE PIPE GALLERY. H. B. Dietz, Jr. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 28, 1962. Contract AT(11-1)-Gen-8. 25p.

The effects of a possible sodium-water reaction in the SRE (Sodium Reactor Experiment) pipe galleries were analyzed. Possibilities for this reaction were considered very remote. Standing water from some unspecified source was assumed to be present in the gallery, and a sodium leak of $^1/_2$ gpm was also assumed. The sodium-water reaction would progress with the generation of heat and hydrogen gas, as follows: $Na_l + H_2O_l \rightarrow NaOH_s + {^1/_2}H_{2g}$, $\Delta H^0_{298} = -35.3$ kcal/mole. The noise and flame generally associated with the sodium-water reaction is due to the hydrogen-oxygen sodium-oxygen reactions. There is less than 1% oxygen present in the galleries, which prevents any appreciable oxygen reactions. The proposed reaction begins with the presence of a minimum of 148 gal of water on the gallery floor. When the gallery pressure reaches 5 in. of water the vent system will begin operation, removing 40 cfm and operate for over 3 hr. The galleries will contain the gas pressure to 6 psig for $4^1/_2$ additional hours. This would give a total time of 7.5 hr for the sodium leak to be stopped. The maximum activity of the high bay during the postulated incident is 3.3×10^{-4} μC/cm³. (M.C.G.)

24895 (NP-13900) SYMPOSIUM ON COMPACT REACTOR TECHNOLOGY. (Martin-Marietta Corp. Aerospace Div., Baltimore). Nov. 14, 1963. 225p.

Separate abstracts were prepared for eight papers. The other two papers on nuclear analysis of the Army Reactor (PM) core 3 and a water-cooled thermoelectric portable power plant were previously abstracted for NSA (18: 3236 and 13282). (D.C.W.)

For abstracts of individual papers see: 24896, 24897, 24898, 24899, 24900, 24901, 24902, and 24903.

24896 (NP-13900(Sect.1)) PM-1 PLANT PACKAGING. Ronald Dugas (Martin-Marietta Corp. Aerospace Div., Baltimore). 14p.

The design criteria for the package are summarized, and the package (package-shelter) is briefly described. Difficulties in its development are discussed; and the structural tests performed on the package are summarized, together with the demonstration of the feasibility of handling and transporting a typical package. (D.C.W.)

24897 (NP-13900(Sect.2)) MATERIAL AND DESIGN CONSIDERATIONS IN THE PM-1 REACTOR VESSEL. Rupert Phipps and Jack Goeller (Martin-Marietta Corp. Aerospace Div., Baltimore). 20p.

The reactor shield water tank was the shipping module for the PM-1 reactor vessel. Therefore, the vessel diameter, as well as its weight, had to be minimized to meet the air shipment size limitations. The design and fatigue considerations, fabrication, and problem areas are discussed. Austenitic stainless steel 347 was selected for the vessel. (D.C.W.)

24898 (NP-13900(Sect.3)) CHEMICAL ASPECTS OF PM-1 AND PM-3A REACTORS OPERATIONS. Alfred Schneider (Martin-Marietta Corp. Aerospace Div., Baltimore). 17p.

The areas in which chemical control is necessary are summarized, together with the parameters monitored. The chemical operating limits used in the early operation of the reactors are given; and the problems created by decomposition of the water under radiation are discussed. The results of analyses of water in the various systems are included, showing the success of the control efforts. (D.C.W.)

24899 (NP-13900(Sect.4)) PM ADVANCED CORE DESIGNS. Thomas Cox (Martin-Marietta Corp. Aerospace Div., Baltimore). 25p.

The design of the PM-1 Core 1 is reviewed; and the Core 2 (now being manufactured), which will have about 50% more life than Core 1, is described. The design effort to date on Core 3, which will provide a power increase from 10 to 40 Mw (thermal), is summarized. The characteristics of the three cores are compared, and the tests associated with the core development program are described. (D.C.W.)

24900 (NP-13900(Sect.6)) PORTABLE NUCLEAR POWER PLANTS. Paul McGill (Martin-Marietta Corp. Aerospace Div., Baltimore). 17p.

The design criteria established for portable plants are reviewed, and the extent to which current designs meet the criteria is evaluated. The economic aspects are considered in detail. Costs for present portable nuclear plants are compared with those for conventional plants, and the prospects for the future are considered. (D.C.W.)

24901 (NP-13900(Sect.8)) HIGH PERFORMANCE WATER PLANTS. Robert Magladry (Martin-Marietta Corp. Aerospace Div., Baltimore). 14p.

Some of the bases for the selection of the design proposed for the Second Generation Portable Nuclear Power Plant are indicated. The functions that water can perform in a nuclear power plant are reviewed, and possible portable water systems based on a Rankine cycle are evaluated. Only systems with one or two fluid loops and using air as the final heat sink medium are considered. (D.C.W.)

24902 (NP-13900(Sect.9)) P_4S_3-COOLED THERMOELECTRIC REACTOR PLANT CONCEPTUAL DESIGN. Charles Murphy (Martin-Marietta Corp. Aerospace Div., Baltimore). 33p.

The results of a feasibility study of the P_4S_3-cooled thermoelectric portable power plant are presented. A 1300-kw(e) plant was studied, in which P_4S_3 vapor from the reactor is transported to the thermoelectric generator by natural circulation. A constant temperature gradient is maintained across the thermoelectric elements by condensing P_4S_3 at the hot junction and boiling water at the cold junction. The proposed reactor, systems, and generator are described; and plant control and operation are discussed. (D.C.W.)

24903 (NP-13900(Sect.10)) A 100-kwe UNDERWATER THERMOELECTRIC REACTOR PLANT CONCEPTUAL DESIGN. Kenneth Dufrane (Martin-Marietta Corp. Aerospace Div., Baltimore). 48p.

A self-pressurized, natural-circulation, pressurized-water reactor system is described that provides a steady-state power output of 100 kw(e) by rejecting heat to the sea water environment through thermoelectric elements. The plant is designed for remote startup and unattended operation at depths up to 3000 fathoms. The requirements imposed upon the concept and the resulting design and performance characteristics are outlined. The special features, potential, and technology of the concept are also discussed. (D.C.W.)

24904 (NP-13904) STUDY OF FUEL CYCLES IN ORGANIC MODERATED REACTORS (thesis). Marc Waucquez (Louvain, Belgium. Universite). June 1960. 133p.

Submitted to Massachusetts Inst. of Tech., Cambridge.

The fuel cycle analysis of a 560 Mwt, 150 Mwe, organic moderated reactor was extended to stepwise out-in fuel movement for four values of fuel enrichment (1.8, 2.0, 2.4, and 2.8 at.%). For the analysis the reactor was divided into three equal volume zones, and the fuel was moved zone by zone toward the center when the reactor was no longer critical with all poison out. New fuel was fed into the outer zone, and spent fuel was discharged from the center zone. The results of the analysis were compared with those of two previous analyses based on batch irradiation and graded fuel movement. (D.E.B.)

24905 (NP-13905) FUEL CYCLES IN A HEAVY WATER MODERATED NATURAL URANIUM FUELED REACTOR (thesis). Bernard J. Van Ommeslaghe (Brussels. Université). June 1958. 108p.

Submitted to Massachusetts Inst. of Tech., Cambridge.

Fuel costs were calculated for a reactor (110 Mwe) cooled and moderated by heavy water and fueled with Zr-clad natural U metal. Costs were calculated for different U^{235} enrichments and for Pu recycle runs up to five core loadings. The calculations are outlined, and the results are presented. (D.C.W.)

24906 (NYO-10719) FEASIBILITY STUDY OF A DUAL-PURPOSE NUCLEAR REACTOR POWER PLANT FOR THE FLORIDA KEYS. (Burns and Roe, Inc., New York). Mar. 1964. Contract AT(30-1)-3277. 206p.

The application of nuclear energy to the desalination of water is an area where there is much promise for a near-term economically competitive situation with fossil-fueled heat sources. Nuclear reactors can be used in one of two ways to produce the process steam needed for desalting sea water. The possibilities are: (1) design a reactor with minimum capital and fuel costs to produce low-pressure steam exclusively and directly; or (2) design a reactor system that will produce electricity by a turbine generator, either backpressure or extraction, and use the backpressure or extraction steam as the heat source for the water desalination plant. This investigation concentrated on the second possibility because the first approach would have no economic advantage over a fossil-fuel-fired single-purpose water plant in the applicable water capacity ranges. Based on steam and electrical requirements determined from studies of combined desalination and power plant installations in the Florida Keys conducted for the OSW under a parallel contract, it was established that reactor power levels in the range 120 to 220 Mw(t) would be required. To obtain valid information for comparison of boiling- and pressurized-water reactor systems in the selected size range, proposals were requested and received from five reactor manufacturers. Two of these proposals were based on the boiling-water concept and the remaining three utilized pressurized-water reactor designs. All of the proposals were evaluated on a uniform basis, insofar as practicable. Where such items as auxiliary systems or steam generators for brine steam (in the case of the boiling-water designs) were not included in the quoted costs, adjustments were made accordingly. This brought each bid to the same degree of completeness and thus normalized the overall installed costs. Features considered, in addition to costs, were reliability, proven design, operability and maintainability, efficiency and safety, and vendor experience. From a comparison of all the factors considered it was concluded that the proposals from Vendor A met the design requirements and were best suited economically for furnishing electricity and steam, in a dual-purpose combined power and water desalination plant. To verify quoted figures, detailed fuel cost calculations were made and compared with the figures given by Vendor A. Fair agreement was found; our costs were 24.3 cents/million Btu as compared to the Vendor A estimate of 21 cents/million Btu. Among the factors that account for the differences are the allowances for fuel processing, the estimated batch size charged to the reactor per refueling operation, and the daily separation plant charges. Since the fuel cycle data submitted by Vendor A are estimates (and most likely conservative) for proposal purposes, a more detailed and precise determination of differences would not be warranted for this study. However, to ensure adequate margins in calculating nuclear power costs, nuclear fuel costs of 24.3 cents/million Btu were used. Using the Vendor A designs producing 412 and 700 psia steam, preliminary studies were made of the steam costs to a desalination plant producing 6,000,000 gallons per day of fresh water, which was the basis used prior to the final selection of the water plant capacity. These initial calculations showed that the 700 psia steam reactor design gave the lower power costs of the two pressures offered. Further, the incremental increase in power costs resulting from a power plant designed to meet combined needs, as compared to an unassociated power plant, were smaller for the nuclear system than for a fossil-fueled plant. It was found, after developing costs for brine heater steam extracted at pressures of 37.9, 49, and 67 psia, that the lowest-pressure steam had the least cost. While the initial studies were based on a water plant capacity of 6,000,000 gallons per day, detailed present worth analyses of six water supply patterns, performed for the Office of Saline Water, showed that 10,000,000 gallons per day of fresh-water production was the optimum plant capacity. Similarly, it was determined that a single power plant, rated at a net output of 50 Mw(e) and designed to furnish electricity to both the Upper and Lower Keys, was the most economical unit to install initially. Studies of site characteristics showed that Sugarloaf Key was best suited for the installation of the nuclear dual-purpose facility. The results of the calculations for the recommended combined plants are summarized, with the fossil-fueled units included for comparison. Steam costs from the nuclear plant were found to be lower than the corresponding costs from fossil plant. This situation, which is unusual for nuclear plants of comparatively low outputs, is largely due to four factors: (a.) The compact Vendor A primary system design combined with the pressure suppression containment building arrangement results in a nuclear plant of low first cost. (b.) Use of municipal financing with its lower fixed charge rate than industrial financing decreases the disadvantage of the higher nuclear plant first cost compared to fossil-fuel plants. (c.) The nuclear fuel costs for the selected reactor design are comparatively low at 24.3 ¢/10^6 Btu. (d.) The fuel oil cost of 42 ¢/10^6 Btu at the Florida Keys is relatively high. The analyses of electric power costs are based on normal economics, i.e., no subsidies or monies for research and development assistance or for design support were assumed for the nuclear reactor system. Further, fuel costs include fuel use charges as well as all other factors. For the nuclear reactor systems the fixed charge items were based on municipal financing and were established as 7.30 percent per year for depreciating capital and 5.17 percent per year for nondepreciating capital. For fossil-fuel plants the insurance allowance was reduced to 0.35 percent, thus yielding 7.15 percent and 5.02 percent for depreciating and nondepreciating capital respectively. The results of this study indicate an economic advantage for a dual-purpose nuclear power and water desalination plant, as compared to a fossil-fuel-fired unit with similar capacities and functions. Because of the economic savings shown, and the anticipated advancements in the state-of-the-art attendant to the application of combined nuclear power and large-scale water desalination, the reactor system described is recommended as the basis for detailed engineering designs of dual-purpose plants in the Florida Keys. (auth)

24907 (ORNL-TM-870) MSRE CAPSULE IRRADIATION EXPERIMENT, ORNL-MTR-47-3. C. A. Brandon and J. A. Conlin (Oak Ridge National Lab., Tenn.). May 22, 1964. Contract [W-7405-eng-26]. 41p. (CF-55-12-18)

The design and operation of one of a series of molten-salt fuel capsule experiments is described. The experiment involved the simultaneous irradiation of four capsules containing graphite crucibles into which molten salt fuel and materials' specimens were placed in contact with one another. The capsules were irradiated for a three-month period at fuel power densities in the range of 200 w/cc and temperatures from 790 to 900°C. The combined effects of radiation, fissioning, and temperature on the properties of graphite reactor structural materials and fuel in contact with one another are being evaluated. (auth)

24908 (PWAC-412) HARMONIC DRIVE DEVELOPMENT. E. J. Zigmond (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Mar. 18, 1964. Contract AT(30-1)-2789. 36p.

The Harmonic Drive was selected as the most practical method for providing rotation of the reactor control drums in the Lithium Cooled Reactor Experiment (LCRE). In addition to providing a zero leak seal, it also embodied a 91.5 to 1 low backlash gear reduction which simplified the drum drive gear boxes. The state-of-the-art for operation of non-lubricated harmonic bearings and gears at 600°F indicated that a comprehensive development program was required to provide engineering assurance that the concept and hardware fabrication were feasible. (auth)

24909 (PWAC-416) LCRE AUXILIARY SYSTEMS TERMINATION REPORT. H. J. Banach (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Mar. 9, 1964. Contract AT(30-1)-2789. 96p.

The Lithium-Cooled Reactor Experiment (LCRE), designed as a "proof-of-principle" test for a lithium-cooled, high temperature, intermediate-fast-flux, 10-Mw reactor, is described. The functional design, including design requirements, capabilities relative to requirements, and development problems, for reactor instrumentation and control systems, liquid metal system instrumentation, electric heating systems, gas systems, mechanical and electrical systems and equipment, is discussed. The procurement and fabrication status of these systems are reported, and manpower and cost estimates are included. (L.B.S.)

24910 (SRO-101) HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT, APRIL 1964. (Savannah River Operations Office, AEC). 9p.

Information is given on the development of an on-power fueling machine for CANDU; creep-rupture tests on SAP; heat transfer in water and steam–water flows through piping; hydridation of Zircaloy; and operations of CVTR and HWCTR. (T.F.H.)

24911 (TID-7690) ROTATING MACHINERY FOR GAS-COOLED REACTOR APPLICATION, GATLINBURG, TENNESSEE, NOVEMBER 4-6, 1963. (Oak Ridge National Lab., Tenn.). 384p. (CONF-251)

Twenty-one papers are included. Separate abstracts were prepared for 16. Five papers were previously abstracted for NSA; see abstracts 18: 373, 1845, 3063, 6489, 9728. (M.J.T.)

For abstracts of individual papers see: 23741, 23742, 23743, 23744, 23745, 23746, 23747, 23748, 23749, 24823, 24912, 24913, 24914, 24915, 24916, and 24917.

24912 (TID-7690(p.1-15)) DESCRIPTION AND PERFORMANCE OF THE PRIMARY CIRCULATORS FOR THE A.V.R. BROWN BOVERI-KRUPP REACTOR, JÜLICH, GERMANY. H. Baumann (Brown, Boveri and Co. Ltd., Baden, Switzerland).

The reactor core design has the result that the circulating cooling gas becomes radioactive. Thus special problems of safety and sealing are posed. The need to enclose the motor in the pressure vessel necessitated a complicated system for oil supply to the bearings and for their sealing. To measure and check circulator properties, a full-scale mock-up of a circulator was built. Tests carried out with air demonstrated that all the requirements could be satisfied. The circulator proved very stable in operation, thanks to the use of a diffuser without blades and a low pressure ratio. A pumping limit was barely discerned, so that the unit can be run up against the full back pressure. Circulator design and operation, bearings, labyrinth seals, oil supply and filtering, and assembly to the reactor are discussed. (M.J.T.)

24913 (TID-7690(p.16-75)) TURBO-CIRCULATOR FOR GCR-4 REACTOR SYSTEM. P. A. Berman (Westinghouse Electric Corp. Small Steam and Gas Turbine Div., Lester, Penna.).

The gas turbine portion of a combined gas–steam turbine power plant is described. The initial cycle and parametric studies from which two cycle concepts were selected for design evaluation are presented. The designs are based on present technology and are sufficient in detail to ensure that both concepts are workable systems. For evaluation, comparisons between the two concepts are presented. A discussion is also included covering the potential problem areas with increased temperature operation in moving from present technology to 1972 technology. (auth)

24914 (TID-7690(p.143-65)) EXPERIMENTAL GAS-COOLED REACTOR SHAFT SEALS. D. R. Patterson and Alex Ridings (Tennessee Valley Authority, Oak Ridge, Tenn.).

The characteristics and the shaft-seal requirements of EGCR are outlined. Development and testing of water-buffered, floating-bushing seals are described. A seal failure, its possible causes, and ensuing alterations in the seals are recounted. (M.J.T.)

24915 (TID-7690(p.166-75)) TEMPERATURE DISTRIBUTION IN THE EGCR VESSEL COOLING COMPRESSOR. Mancil W. Milligan (Tennessee. Univ., Knoxville).

As a part of the rework design of the primary seal in the vessel cooling compressor, an analysis was made to establish the temperature distribution in the seal and shaft area of the compressor. To accomplish this task in a short time an existing digital computer program was utilized to solve the finite-difference equations. This Generalized Heat Conduction Code is available on the SHARE PROGRAM; it was originally written for the IBM-704 Computer but was revised for IBM-7090 Computer. (auth)

24916 (TID-7690(p.189-206)) DESCRIPTION AND PERFORMANCE OF THE PRIMARY CIRCULATORS FOR THE O.E.C.D. HIGH-TEMPERATURE REACTOR PROJECT DRAGON, ENGLAND. H. Baumann (Brown, Boveri and Co. Ltd., Baden, Switzerland).

The main coolant circulators are totally enclosed blowers with hydrodynamic gas-lubricated bearings. Because the reactor is to be used for experimental work, a very wide working range was specified for the circulators. The blowers must be able to withstand relatively rapid changes in temperature, pressure, and speed. It must be possible to stop and restart them at high temperature. Provision must be made for operating the six circulators in parallel. Circulator design — casing, internals, impeller, shaft, bearings, jacking gas, thermal problems, electric bushings, instrumentation — is described. Development of gas-lubricated bearings is discussed. Test experiences and results are recounted. (M.J.T.)

24917 (TID-7690(p.207-18)) THE ROLE OF GAS-BEARING CIRCULATORS IN THE DRAGON REACTOR. W. F. Shilling (Oak Ridge National Lab., Tenn.).

Gas-bearing circulators are used in the primary coolant circuit and in other parts of the reactor such as the helium purification plant. The general reactor layout and a cross section of the heat exchangers and circulators are diagrammed. Safety and emergency requirements and procedures are outlined. The reactor test program and results are described. The use of gas bearings on ancillary units is discussed. (M.J.T.)

24918 (WAPD-PWR-TE-159(Rev.)) PERIODIC CALIBRATION OF TEMPERATURE SENSING ELEMENTS—REACTOR PLANT PORTION. ALL CORE 1 SEED 4 PERFORMANCES. Test Evaluation—DLCS-24301. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Jan. 1964. Revised May 1, 1964. Contract AT-11-1-GEN-14. 7p.

Results of performance tests on immersion and resistance thermometers used in the Shippingport reactor are presented. In some cases excessive drift was found that dictates a change in the type instrument used. (D.E.B.)

24919 (ORNL-tr-82) NEW DESIGN OF REACTOR COMPLEX AND OF LOADING MECHANISM. R. Martin (Commissariat a l'Energie Atomique, Paris) and B. Saiteevsky (France. Electricite de France, Paris). Translation of a Paper From the Societe Europeenne Energie Atomique Symposium, Cannes, France, 1962. 30p.

Improvement of the efficiency of natural uranium-graphite-gas reactors is discussed, using the EDF3 reactor as the conventional standard. An entirely integrated design and loading mechanism is presented and examined in which the reactor handling equipment, heat exchangers, and blowers are contained in a prestressed concrete vessel. An inverse gas flow is also featured. (D.C.W.)

24920 SURVEY OF E.D.F. 4 OF THE SAINT-LAURET-DES-EAUX POWER STATION. C. Bienvenu and J. Hillairet. Bull. Inform. A.T.E.N. (Assoc. Tech. Energie Nucl.), No. 46, 45-54(Mar.-Apr. 1964). (In French)

The bases for the design and arrangement of the EDF4 station are reviewed; and the entire facility including the reactor, building, pressure vessel, generation equipment, and systems is briefly described. The plant characteristics are also tabulated. Notably, a prestressed concrete pressure vessel is used, and the gas coolant (CO_2) flow is inverse (top to bottom). Power output is 475 Mwe. (D.C.W.)

24921 THE PART OF CLASSICAL METROLOGY IN PHYSICAL TESTS OF NUCLEAR REACTORS. M. R. Roche. Bull. Inform. A.T.E.N. (Assoc. Tech. Energie Nucl.), No. 46, 55-64(Mar.-Apr. 1964). (In French)

Difficulties with the measurements made at low power and during power buildup are discussed in relation to experience with the EDF1 reactor. Solutions tested in the initial operation of the EDF1 are described. Recommendations for further improvement of the measurements are made. (D.C.W.)

24922 NUCLEAR POWER IN THE PORTUGUESE GENERATING SYSTEM. Antonio Leite Garcia. Energia Nucl. (Lisbon), 1: 11-19(Mar. 1963). (In Portuguese)

The structure of the Portuguese electric system during the transition period from a mainly hydroelectric system to a mainly thermal one is analyzed. Considering the local economic conditions, the minimum utilization that can be accepted for a nuclear plant is determined. The result is quite fair to nuclear power because of the good conditions existing in Portugal for this kind of energy. The integration of thermal power is studied, bearing in mind the rising in future loads and the full profit of water in all wet years. On the neighborhood of the hypotheses, it seems that the nuclear power will be necessary in Portugal when the year load is closed to the average production of the hydroelectric system then existing. (auth)

24923 LATINA POWER STATION. J. Watson and W. Macrae. J. Brit. Nucl. Energy Soc., 3: 75-93(Apr. 1964).

A detailed description of the Latina power station is presented. Organization, staffing, and problems associated with carrying out the contract are discussed, as well as the commissioning phase of the project. (L.B.S.)

24924 PROTECTION OF BOILING WATER REACTORS AGAINST EXCESSIVE STEAM DEMAND. J. H. Bowen (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). J. Brit. Nucl. Energy Soc., 3: 111-18(Apr. 1964).

The performance of a boiling water reactor channel was calculated to define the limits to be placed on the initial channel parameters, if the system is to withstand, without burnout, a prescribed rate of loss of pressure. The principal simplifying inaccuracy of the calculation is that boiling is assumed to commence at a channel length corresponding to the bulk saturation point. Conclusions are drawn: on the conditions for flow stabilization; on the optimization of burnout margin vs. pumping power; on the shut-down performance required; and on the specification of the circulating pumps against transient pressure drops and sub-cooling fluctuations. Where part of the steam circuit of a direct cycle BWR is uncontained, it is recommended that such precautions be adopted against burnout in case of steam main fracture. (auth)

24925 FINDING FAILED FUEL IN CANDU. James F. Palmer (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucleonics, 22: No. 6, 39-40; 42-4(June 1964).

All 306 fuel channels will be continuously monitored in CANDU with a system that can identify 10-mil pinholes by power cycling, and can instantly locate a major cladding failure within a group of 8 channels. (auth)

24926 STRUCTURES FOR NUCLEAR POWER. S. Gill. London, C. R. Books Limited, 1964. 398p. 120s.

A record of problems and solutions of practical structural design of reactor components, mainly the biological shield, foundations, and concrete pressure vessels, is presented from the viewpoint of the civil engineer for the first decade in the development of peaceful uses of nuclear power. Concretes used in reactor construction are discussed. Seismic and other design codes are discussed. (R.E.U.)

24927 ENGINEERING PROBLEMS IN NUCLEAR THERMIONIC POWER SYSTEMS. George N. Hatsopoulos and Robert C. Howard (Thermo Electron Engineering Corp., Cambridge, Mass.). New York, Society of Automotive Engineers, 1964, Preprint 861C, 11p. (CONF-505-4)

From Society of Automotive Engineers Air Transport and Space Meeting, New York, Apr. 1964.

Both the potential uses and the problems of nuclear thermionic reactor systems are discussed. The various design concepts for utilizing thermionic conversion in space reactor powerplants are summarized and evaluated. The in-core concept, now receiving the greatest interest, is described in some detail. The major problems of this concept and the progress made thus far toward their solution are reviewed. The overall state-of-the-art of thermionic conversion is also discussed from an engineering point of view, and estimates are given of the progress in thermionic conversion which can be anticipated within the next few years. (auth)

24928 IMPROVEMENTS IN OR RELATING TO STEAM GENERATING NUCLEAR REACTORS. John Tatlock (to United Kingdom Atomic Energy Authority). British Patent 956,862. Apr. 29, 1964. Filed Dec. 9, 1959.

The design of a steam-generating reactor with improved stability and flux distribution and reduced capital cost is patented. The reactor is moderated by heavy water, cooled by steam from a light-water coolant, and fuelled by UO_2. When generating steam, the volumetric ratio of heavy water to UO_2 is in the range of 4.0 to 8.0, and the volumetric ratio of light water to UO_2 is in the range of 0.36 to 1.1. The ratios are expressed in relation to UO_2 at 94% of theoretical maximum density. (M.P.G.)

24929 METHOD FOR THE EXTRACTION OF PLUTONIUM RESP. URANIUM 233 FROM SURFACE LAYERS OF FUEL ELEMENTS. Kurt Diebner and Erich Bagge. German Patent 1,163,465. Feb. 20, 1964. Filed Sept. 20, 1960.

The method comprises the steps of attaching layers of breeder material in the form of thin, jacketed foils to the fuel elements, of removing these foils after a predetermined irradiation time, and of processing the foils. It is proposed to use thin sheet metals of natural uranium, enriched uranium, or mixtures of other nuclear fuel with ^{238}U and ^{232}Th. (Gmelin Inst.)

24930 STEAM COOLED NUCLEAR POWER PLANT. Jakob Kaegi (to Gebruder Sulzer AG). German Patent 1,163,991. Feb. 27, 1964. Priority date Sept. 21, 1960, Switzerland.

A nuclear power plant is described in which the reactor core is cooled by steam, the complete stream of cooling vapor being divided into two streams, one stream being supplied as working medium to a prime mover, expanded therein and subsequently condensed while the second stream is circulated by a blower and cooled by vaporizing the condensed first stream. The second stream passes as the primary medium through a heat exchanger and then through the blower while the condensed first stream is pressurized by a pump, then passes as the secondary medium through the heat exchanger where it is at least partly vaporized, and is then mixed with the second stream downstream of the blower. The blower power is reduced considerably. (Gmelin Inst.)

24931 NUCLEAR POWER PLANT FOR THE GENERATION OF SUPERHEATED STEAM. Norman Bradley (to United Kingdom Atomic Energy Authority). German Patent 1,167,991. Apr. 16, 1964. Priority date Oct. 28, 1958, Great Britain.

A system is described whereby working fluid is converted from a liquid to saturated vapor state by heat exchange in evaporators and from a saturated vapor state to superheated state by nuclear heat, some of the superheated fluid being utilized to produce mechanical energy and some being utilized in the evaporators to produce saturated vapor. Superheated steam pipes couple respectively from passes at the outlet from the reactor to the inlet steam side of the evaporators and saturated steam pipes couple respectively from evaporators to the passes at the inlet of the reactor. (Gmelin Inst.)

Production Reactors

24932 (HW-SA-3018) AUTOMATED WATER QUALITY MONITORING SYSTEM FOR THE NEW PRODUCTION REACTOR. T. F. Demmitt and W. D. Bainard (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [May 20, 1963]. Contract AT(45-1)-1350. 11p. (CONF-157-7)

From the American Chemical Society Northwest Regional Meeting, Bellingham, Wash., June 1963.

A summary of the New Production Reactor coolant systems design is presented, and the automatic monitoring system that will be employed to obtain information concerning the purity of the various coolant streams is described in detail. (C.E.S.)

Propulsion and Space

24933 (AFSWC-TDR-63-51) PARTICLE DISINTEGRATION STUDY FOR RE-ENTERING NUCLEAR AUXILIARY POWER SYSTEMS. Final Report. A. E. Levy-Pascal, L. E. Bell, R. R. Koppang, A. H. Malinovsky, S. W. Pohl, R. Silvestri, and N. A. Tiner (Astropower, Inc., Newport Beach, Calif.). June 1963. Contract AF29(601)-5004. 76p. (AD-414394)

The purpose of the study was to determine the chemical history and related physical phenomena of liquid Zr-U droplets in the presence of a flowing mixture of atmospheric gases at various partial pressures. A theoretical analysis of the aerodynamic and thermodynamic conditions affecting the droplets was carried out. Experimental investigation was conducted on the interaction of particles of 50- to 200-micron size with oxygen and nitrogen at different concentrations and total pressures. The results obtained indicate that the droplets undergo partial or complete oxidation or nitridation, depending on experimental conditions. Only when oxygen was present did the droplets disintegrate into submicron particles. The frequency and mode of disintegration depend on the total pressure, oxygen concentration and particle size; however, specific variables should be further investigated in order to reach more quantitative and realistic conclusions. (auth)

24934 (ANP-53) REPORT OF THE SHIELDING BOARD FOR THE AIRCRAFT NUCLEAR PROPULSION PROGRAM. (Fairchild Engine and Airplane Corp. NEPA Div., Oak Ridge, Tenn. and Oak Ridge National Lab., Tenn.). Oct. 16, 1950. Contract W-7405-eng-26. 225p.

Subjects included in the shielding report are: weights of shields, choice of coolant; design, specifications, requirements for delayed radiation, minimum weight considerations, and shielding of homogeneous or circulating fuel reactors with unit shield; design of divided shields; and relations of shielding and aircraft design. (R.E.U.)

24935 (APEX-260) NAVY SEAPLANE POWER PLANT STUDY; COMPACT CORE REACTOR TYPE. VOLUME IV. CONTROL SYSTEM. E. B. Delson (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 1956. Contracts AF33(038)-21102 and AT(11-1)-171. 70p.

The development of a proposed integrated control system for the operation of an aircraft power plant consisting of an NDA compact-core reactor and the General Electric X310 engine is discussed. Included are the formulation of transfer functions for the control components and the development of the electronic analog simulator with which the transient studies were performed. The satisfactory operation of the integrated control system is indicated by the response of the composite electronic analog simulator to various disturbances of control parameters. (auth)

24936 (APEX-636) THE DYNAMICS OF THE P-140 REACTOR CORE MOCKUP. A CORRELATION OF EXPERIMENT AND THEORY. E. Ratterman (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). June 13, 1961. Contracts AF33(300)-38062 and AT(11-1)-171. 21p.

A method is presented of correlating the results of vibration and shock tests on the P-140 reactor core mockup with elemental shock and vibration theory. The natural frequency and the spring rate of the spring-mass system, as well as the magnitude and nature of the damping in the system, are developed. (auth)

24937 (APEX-917) ORGANIC, STRUCTURAL AND CONTROL MATERIALS. C. G. Collins (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Dec. 15, 1961. Contracts AT(11-1)-171 and AF33(600)-38062. 55p.

The radiation effects on organic materials used in accessories and controls for the nuclear power plant are described. High-temperature control rod development, radiation effects on high-temperature structural material, and thermocouple development are also discussed. (auth)

24938 (EGG-L-603) KIWI B-1B SUMMARY REPORT. (Edgerton, Germeshausen and Grier, Inc., Las Vegas, Nev.). Mar. 5, 1963. Contract AT(29-1)-1183. 134p.

Instrumentation and control systems, pertinent installation and modification in these systems, and problems in the operation of these systems in support of the Kiwi B-1B series of tests are discussed. The Kiwi B reactor tests represent the prototype phase of the Rover Program, and in particular, the 1B series initiated the use of liquid hydrogen as propellant coolant. Data acquisition and reduction systems are discussed. Successful first operation of two sixteen-decade linear power integrators and wide-band neutronics data equipment is reported. (R.E.U.)

24939 (GEMP-285) 630A MARITIME NUCLEAR STEAM GENERATOR. Progress Report No. 8 (General Electric Co. Advanced Technology Services, Cincinnati). May 1, 1964. Contract AT(40-1)-2847. 51p.

Analyses, fuel studies, material studies, measurements in the Critical Experiment, and configuration evaluations are summarized, together with control development. (D.C.W.)

24940 (NASA-CR-54000) NUCLEAR ROCKET ENGINE NOZZLE STUDY. Final Report. Sidney Elkind (Arde-Portland, Inc., Paramus, N. J.). Feb. 3, 1964. Contract NAS-3-3670. 138p.

A study was made of selected aspects of nuclear nozzles, and an uncooled design for long duration firings was evolved. Nozzle walls that are adequate with limited cooling were investigated and two designs that could be cooled with 5% of core gas flow are described. The effects of startup and shutdown were treated, and use of gas side coatings was investigated. Internal heat generation due to gamma heating was considered and the methods of computing transient temperature distributions are reviewed. Limited stress analysis and comparative weights for both cooled and uncooled nozzles are reported. (auth)

24941 (SC-RR-64-501) RE-ENTRY FLIGHT DEMONSTRATION NUMBER ONE (RFD-1): FINAL SNAP-10A SAFETY FLIGHT-TEST-PLAN. C. E. Erickson, J. I. Hegge, J. Jacobs, R. D. Klett, H. R. Spahr, H. K. Togami, and I. B. White (Sandia Corp., Albuquerque, N. Mex.). Mar. 1963. Contract AT(29-1)-789. 73p.

The disassembly, destruction, and disposal of the SNAP 10A, a 500-w(e) thermoelectric system, are to be studied. The reactor, re-entry vehicle, range, and vehicle and range instrumentation are described; and the objectives, limitations, operations plan, and conditions required to meet the objectives are presented. Ground tests performed on two test vehicles are also summarized. (D.C.W.)

24942 POWER GENERATION AND CONDITIONING FOR SNAP. N. W. Bucci and R. W. Briggs (Westinghouse Electric Corp., Lima, Ohio). Nucleonics, 22: No. 6, 51-4 (June 1964).

Attention is given to power generation, conditioning, and distribution equipment, which can weigh nearly as much as the heat generation and dissipation subsystems. (auth)

24943 MECHANICAL ANALYSIS FOR CYLINDRICAL FUEL ELEMENTS OF A FAST REACTOR FOR USE IN A LUNAR POWERPLANT. Benjamin M. Ma (Iowa State Univ. of Science and Tech., Ames). New York, Society of Automotive Engineers, 1964, Preprint 861B, 11p. (CONF-505-3)

From Society of Automotive Engineers Air Transport and Space Meeting, New York, Apr. 1964.

A theoretical mechanical analysis for strain and stress distributions in a long, solid cylindrical fuel element of a fast reactor suitable for use in a lunar powerplant is presented. Primary effects of thermal-cycling growth, irradiation growth, swelling, and creep developed in the fuel material are taken into account. From basic assumptions, the equations for the components of strain and stress are derived. Based on results of an illustrative example, it is found that the order of magnitude of the neutron flux, degree of irradiation, cladding thickness, and properties have important effects on strain and stress distributions produced in the fuel element. (auth)

24944 DESIGN OF THE SNAP 10A REACTOR. A. W. Dalcher and J. D. Sutherland (Atomics International, Canoga Park, Calif.). New York, Society of Automotive Engineers, 1964, Preprint 861D, 7p. (CONF-505-5)

From Society of Automotive Engineers Air Transport and Space Meeting, New York, Apr. 1964.

The SNAP-10A reactor is a high-temperature, liquid metal cooled reactor designed for satellite and other space applications. The reactor is an integral part of the SNAP-10A system, which is a self-contained power unit producing a minimum of 500 watts electrical. The SNAP-10A reactor structure has been designed to withstand a multitude of environmental conditions, including launch and operational loads, space vacuum, meteoroids, high temperature, nuclear irradiation, and liquid metal corrosion. Other design considerations were fabricability and nuclear, thermal, and mechanical compatibility with the rest of the SNAP-10A system. The validity of the SNAP-10A reactor design has been proven by a comprehensive series of nuclear and environmental tests on both a component and system basis. (auth)

24945 HIGH TEMPERATURE TECHNOLOGY FOR THE SNAP-50/SPUR NUCLEAR ELECTRIC SPACE POWER-PLANT. R. I. Strough and A. I. Chalfant (Pratt and Whitney Aircraft, Hartford). New York, Society of Automotive Engineers, 1964, Preprint 861E, 12p. (CONF-505-6)

From Society of Automotive Engineers Air Transport and Space Meeting, New York, Apr. 1964.

The SNAP-50/SPUR experimental program at CANEL is described including corrosion testing, mechanical properties testing, fuel element testing, boiling heat transfer testing, and testing related to the development of motor pumps and valves. Results of corrosion and mechanical properties testing are presented as well as some of the results of motor pump component testing. It is concluded that most of the basic technological problems of those protions of the SNAP-50/SPUR system which are the responsibilities of Pratt & Whitney, CANEL, have been solved. (auth)

24946 MARINE SHIP REACTOR. Melvin Francis Sankovich, John Frederich Mumm, Donald Christopher North, Jr., Harvey Raymond Rock, and Donald Kermite Gestson (to U. S. Atomic Energy Commission). German Patent 1,161,361. Jan. 16, 1964. Priority date Jan. 29, 1959, United States.

The pressurized light water moderated and cooled reactor described has a core comprising a plurality of extended fuel assemblies containing material fissionable by thermal neutrons, wherein provision is made for passing the light water through the core in three successive passes. Provision is made of a positive sealing arrangement to prevent leakage of first pass moderator, into second pass moderator, which consists of a sealing ring mounted along the top edge of a cylindrical shield and a plurality of coil springs located on the ring for maintaining the latter continuously in a sealing position against the shield during the movement of the reactor. (Gmelin Inst.)

Research and Test Reactors

Refer also to abstract 23809.

24947 (AEET/AM/38) AIRBORNE RADIOACTIVITY AND RADIOACTIVITY IN THE COOLING WATER IN A SWIMMING POOL REACTOR. K. G. Vohra, V. S. Bhatnagar, and A. N. Singh (India. Atomic Energy Establishment, Trombay). 1963. 28p.

The measurement of activation products in the water and solid descendants of fission gases in the air in a swimming pool reactor is described for the Apsara Reactor at Trombay. The fission gas concentrations in the air and water were calculated on the basis of the experimental value of ^{138}Cs (daughter of ^{138}Xe) in the air. (R.E.U.)

24948 (AEET/ROD/6) EXPERIENCE WITH ELECTRONIC EQUIPMENT AT CIR. S. Srinivasan and S. Ramaswamy (India. Atomic Energy Establishment, Trombay). 1963. 16p. (CONF-243-55)

From the American Nuclear Society Conference on Problems of Operating Research and Power Reactors, Ottawa, Oct. 1963.

The 40-Mw Canada-India Reactor uses natural uranium as fuel, heavy water as moderator, and light water as coolant. The electronic equipment at the installation is indicated, and the maintenance schedules for the equipment are outlined. Experience during commissioning and operation is then described, and the effects of service conditions on equipment are discussed. (D.C.W.)

24949 (AEET/ROD/7) CANADA INDIA REACTOR OPERATING EXPERIENCE. REACTOR PHYSICS. N. Veeraraghavan, D. B. Upendra, and R. Narain (India. Atomic Energy Establishment, Trombay). 1963. 33p. (CONF-243-54)

From the American Nuclear Society Conference on Problems of Operating Research and Power Reactors, Ottawa, Oct. 1963.

The natural-uranium, heavy-water-moderated reactor (40 Mw) features light water cooling of the fuel rod assemblies and uses sea water as the secondary coolant. Criticality was attained in July 1960. Experimental observations during the subsequent three years on flux distributions, rod worths, power and temperature coefficients of reactivity, xenon poisoning, primary coolant activity, and fuel rod water temperature transients are reported. The initial approach to criticality is discussed. (D.C.W.)

24950 (AEET/ROD/9) ORGANISATION AND ADMINISTRATION ASPECTS OF REACTOR OPERATIONS. V. Surya Rao (India. Atomic Energy Establishment, Trombay). 1963. 14p. (CONF-523-2)

From the IAEA Study Group Meeting on Operational Problems of Research Reactors and Their Use for Isotope Production and Activation Analysis, Manila, Dec. 1963.

The problems and means for their solution in the operation of research reactor facilities are discussed. Personnel recruiting, reactor operation, and plant maintenance are considered. (R.E.U.)

24951 (ANL-6880(p.1-5)) BOILING WATER REACTORS. (Argonne National Lab., Ill.).

Operations, experimental programs, physics calculations, and radiolytic gas recombination studies in Borax-V are summarized. (T.F.H.)

24952 (ANL-6880(p.6-48)) LIQUID-METAL-COOLED REACTORS. (Argonne National Lab., Ill.).

Studies of the Rapsodie core in ZPR-III are summarized. Operations of ZPR-VI and ZPR-IX are reviewed. Surveys are presented of: development of U–Pu and U–Pu–fissium fuels clad with Nb, Nb–Zr, V, V–Ti, Mo–Ti–Zr, Mo, Hastelloy X, and 304 stainless steel for fast reactors; vibratory-compaction parameters for reactor fuels; development of U, U–Pu, and U–Pu–X (X = Al, C, Cu, Fe, Zr, Mo, or fissium) fuels for zero-power experimental reactors; reprocessing U–Pu–fissium fuels by melt-refining and skull reclamation; separation of Pr from Pu-bearing fuels; the distribution coefficient of Pr between NaCl–KCl–$MgCl_2$ and Cd–Mg–Zn; and the development, operations, and experimental programs of EBR-II and FARET. (T.F.H.)

24953 (ANL-6880(p.68-71)) ADVANCED SYSTEMS RESEARCH AND DEVELOPMENT. (Argonne National Lab., Ill.).

The design, physics calculations, and experimental facilities for the Argonne Advanced Research Reactor (AARR) are reviewed. (T.F.H.)

24954 (IDO-16930) SUMMARY DATA REPORT FOR SPERT TRANSIENT PRESSURE MEASUREMENTS IN THE INTERVAL 1955 TO 1961. G. F. Brockett and E. Feinauer (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 15, 1964. Contract AT(10-1)-205. 141p.

The primary pressure data obtained from Spert nuclear reactor power excursion tests in the interval 1955 to 1961 are presented. The data were obtained during testing of seven plate-type reactor cores of either aluminum or stainless steel construction. The data presentation consists of an extensive display of the pressure-time histories with a limited discussion of pertinent features, a tabulation of peak pressures, and illustrative cross plots of peak pressure as a function of a few appropriate variables, including initial system conditions and reciprocal reactor period. Where appropriate, composite plots showing the simultaneous behavior of pressure, energy, power, temperature, and flow were included to facilitate investigation of the interrelations between these primary variables. Data for both the open vessel Spert I configuration and the closed vessel, pressurized Spert III configuration are included. (auth)

24955 (IDO-16931) SPERT PROJECT. Quarterly Technical Report, July–September 1963. A. H. Spano, ed. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 1964. Contract AT(10-1)-205. 34p.

In preparation for the planned destructive transient test of the low-enrichment, rod-type UO_2 core previously tested in Spert I, transient rod modifications have been made to increase the reactivity available as an effective step insertion for the initiation of the destructive test. Flux distribution and ion chamber power calibration measurements have been completed, and fiducial series of eight power excursion tests performed, with periods from approximately 1 sec to 50 msec. In these tests, the attainment of peak powers somewhat greater than those previously obtained in this reactor period range is believed to be the result of a slight fuel pin bowing effect permitted by the present constraining grid assembly. Calculations have been made for the maximum thermal cladding stress expected during an assumed 1.8-msec-period destructive excursion in Spert I. The results indicate that, if the dynamic stress-relieving effects of clad yielding are neglected, approximately 10 percent of the stainless steel cladding in the core will experience stresses in excess of the measured ultimate value. Under such conditions, rupture of the fuel rods followed by an acoustically rapid dispersal of the hot fuel in the water can lead to the generation of a pressure pulse of destructive magnitude. In Spert II, following the attainment of an operational core loading of highly enriched, plate-type, aluminum-clad fuel assemblies moderated by heavy water, reactivity calibrations of the control and transient rods were completed, and detailed measurements made of the thermal and epicadmium neutron flux distributions in the core and reflector regions. The flux mapping results obtained indicate a highly depressed power distribution in the central core region relative to the peripheral core region, a distribution characteristic of the highly under-moderated system provided by the close-packed configuration of the D_2O-moderated fuel assemblies. Following extended shutdown of the Spert III facility, which resulted from failure of the pressurizer vessel, nuclear operations were resumed with the reestablishment of the previous operational core loading of highly-enriched, stainless steel-clad, plate-type fuel assemblies, and preparations were made for the completion of the previous investigation of the kinetic behavior of this core under conditions of high system temperature, pressure, and flow. In the present loading experiment the critical position and rod calibration data obtained in the original start-up of the Spert III core were essentially reproduced, indicating no changes in core characteristics. Flux distribution and ion chamber power calibration measurements under system temperature conditions of 500 and 600°F were completed. In Spert IV, an additional series of power excursion tests with 12 ft/sec forced coolant flow were carried out to obtain additional information on the conditions which resulted in the melting of a fuel plate during a 10-msec-period test. The stability test series was initiated, with studies of the relative stability characteristics of the reactor as a function of power level and reactivity insertion, for the case of an 18-ft hydrostatic head and no forced coolant circulation. (auth)

24956 (IDO-16961) STEP PROJECT. Quarterly Technical Report, Period Ending June 30, 1963. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Mar. 1964. Contract AT(10-1)-205. 119p.

In the Safety Test Engineering Program (STEP), kinetic tests performed on reactors proposed for space applications to assess the behavior and hazards resulting in power excursion accidents and engineering scale tests on power reactor systems to assess the consequences of nuclear accidents are being developed. Kinetic tests will be conducted on a modified SNAP 2/10A reactor. The test program is designated as SNAPTRAN (SNAP-transient tests) and consists of two series of experiments. The SNAPTRAN 2/10A-1 test series will investigate the kinetic behavior of a beryllium-reflected flight-type reactor; the SNAPTRAN 2/10A-3 test series will investigate the consequences of a nuclear excursion resulting from immersion of the reactor in water. Under the Engineering Field Test category, studies were made of the two types of accidents most frequently postulated as the maximum credible in hazards analysis. These are the loss of coolant accident and the reactivity-type accident. One experimental program is being considered, and a conceptual design prepared for a test package and facility to determine the hazards and consequence of the loss of coolant accident. This test program is designated LOFT (Loss of Fluid Tests). The LOFT program will investigate the blowdown phenomena associated with the breach of the primary system; the resultant core meltdown, fission product release, transport, and plateout; the pressure buildup within the containment; and the leakage of the environment. Investigation of catastrophic reactivity-type accidents is being studied on two types of reactors, a liquid full, pressurized water reactor, and a boiling water reactor. Programs are being considered and conceptual designs prepared to achieve the program objectives for both types of reactors. (auth)

24957 (NDL-TR-59) NEUTRON-FLUX AND GAMMA-DOSE MEASUREMENTS AT THE AFRRI REACTOR. John R. Jacobson, David T. Kilminster, John H. McNeilly, and Robert J. Smith (Army Nuclear Defense Lab., Edgewood Arsenal, Md.). Sept. 1963. 86p.

A neutron threshold-detector system was used to measure the neutron environment of the Armed Forces Radiobiology Research Institute Reactor. Gamma dosimetry for the facility was accomplished by use of film dosimeters, silver-activated phosphate glass rods, and cobalt-activated borosilicate glass plates. The experimental design was such that a thorough and comprehensive description of the radiation environment in the two exposure rooms of the reactor facility was obtained. A total of 1,543 neutron-flux measurements and 437 gamma-dose measurements was made. The results of neutron-flux measurements in the thermal neutron exposure room indicate a thermal neutron flux ($E_n < 0.3$ ev), approximately 2×10^3 times greater than the flux of fast neutrons with energies above 1.5 kev. (auth)

24958 (NP-13907) IZUCHENIE I ULUCHSHENIE EKSPLUATATSIONNYKH VOZMOZHNOSTEI I OPYT EKSPLUATATSII REAKTORA VVR-M INSTITUTA FIZIKA A N USSR. (Study and Improvement of Performance Possibilities and Operating Experience with the Water/Water Reactor for Materials (VVR-M) of the Physics Institute). M. V. Pasechnik, I. F. Barchuk, D. T. Pilipets, F. A. Grinevich, M. M. Nazarchuk, and S. O. Slesarevskii. Kiev, Publishing House of the Academy of Sciences, 1963. 20p.

The three-year performance of the VVR reactor during experimental studies is described as well as the maintenance and studies of reactor operational parameters. Measurements of fuel element wall and core cooling are discussed. It is shown that the temperatures along the fuel elements depend on position. An account is given of the errors made in closed circuit degassing and thermal desalting of the primary coolant loop, and a new technological scheme and its advantages are described. The method used for examining irradiated fuel elements for leaks is also described. (R.V.J.)

24959 (NP-13910) ISSLEDOVANIYA PO YADERNOI FIZIKE I FIZIKE TVERDOGO TELA NA REAKTORE IRT IAE IM. I. V. KURCHATOVA. (Research in Nuclear and Solid-State Physics with the Thermal Research Reactor (IRT) of the Atomic Energy Institute imeni Kurchatov). A. M. Demidov and M. I. Pevzner (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). 1963. 23p.

The principle work was confined to investigations of γ spectra, internal conversion in (n,γ) reactions, and fission physics. Solid state studies were limited to neutron diffraction analysis and condensed state dynamics. Data are given on samarium γ spectra at 5.2 to 8.0 Mev and 0.3 to 1.4 Mev; internal conversion spectra for ^{149}Sm thermal neutron capture, and ^{150}Sm γ-transitions. Phonon spectra for V and Ni were correlated, and excitation spectra for Ti–Zr are given. Spectra for neutrons scattered in liquid benzene, solid diphenyl, and in irradiated and non-irradiated polyethylene are also included. (R.V.J.)

24960 (NP-13911) NEKOTORYE IZMENENIYA KONSTRUKTSII I ISSLEDOVANIE FIZICHESKIKH KHARAKTERISTIC REAKTORA IRT-2000 EI AN BSSR. (Some Structural Changes and Investigation of the Physical Properties of the Research Thermal Reactor IRT-2000). V. A. Borishevich, V. M. Dolgov, M. F. Kokhonov, Yu. G. Nikolaev, A. S. Orlov, V. A. Sokol'chik, and O. I. Yaroshevich (Akademiya Nauk Belorusskoi S.S.R. Energeticheskii Institut, Minsk). 1963. 36p.

Installation of a loop and reconstruction in the active zone of the IRT-2000 improved its efficiency as an experimental facility. A temperature graph shows that for a temperature increase in the active zone from 16 to 35.2°C the change in reactivity is 0.051% ΔK. The reactivity temperature coefficient at 5.8 to 16°C is zero. The mean reactivity temperature coefficient at 16 to 26°C is -1.5×10^{-5} I/°C; at 26 to 31°C, -3×10^{-5} I/°C; and at 31 to 35°C, -4.8×10^{-5} I/°C. The indicated negative temperature coefficients do not influence the poisoning curve of the reactor. (R.V.J.)

24961 (NP-13930(p.80-103)) KERNPHYSIKALISCHE EXPERIMENTE AM FRM. (Nuclear Physics Experiments on the FRM). P. Armbruster (Munich. Technische Hochschule).

The nuclear physics studies carried out on the FRM were divided into two groups: investigations of thermal neutron capture and investigations of fission physics. Studies are outlined and results are presented in graphs. (M.C.G.)

24962 (RT/ING(63)-25) IL REATTORE "ISPRA-2"—DESCRIZIONE DEL REATTORE E RAPPORTO DI SICUREZZA. (The Reactor "Ispra-2"—Description of Reactor and Report of Safety). M. Conti, F. Fioroni, S. Galli, G. Gambardella, A. Mathis, L. Matteuzzi, C. Tamagnini, and R. Zona (Italy. Comitato Nazionale per l'Energia Nucleare. Centro di Studi Nucleari, Casaccia). Oct. 1963. 168p.

ISPRA-2 is a little research reactor, swimming pool type, graphite-reflected, with 100 kw of max power, cooled by natural convection. It was mounted in the storage pool of ISPRA-1 reactor. A general description of the components and an exposition of calculations concerning physics, shielding, and activation are presented. Safety analysis and hazards evaluation are also discussed. (auth)

24963 (TID-20621) ADVANCED TEST REACTOR FUEL PLATE PRESSURE DEFLECTION TESTS. H. D. Ferris and G. A. Jahren (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Dec. 1963. Includes Appendix: FSD—A PROGRAM TO COMPUTE THE STRESSES AND DEFLECTIONS IN THE ATR FUEL ELEMENT. D. B. Wehmeyer and G. A. Jahren. For Ebasco Services, Inc., New York. Contract AT(10-1)-1075. 187p. (ATR-FE-101)

Mathematical procedures were developed to predict the stress and deflection characteristics of the ATR fuel plates. The theory and calculations are summarized, and a test program carried out to examine and extend the calculations is described. Tests on single plate specimens confirmed the effectiveness of membrane forces, as indicated by the calculations. The element spring rate and the effect of combs on plate deflection were also evaluated, and full-sectional specimens with static air pressure and hydraulic flow were investigated. In general, the correlation between the experimental and calculated results was very good. (D.C.W.)

24964 (UCRL-7695) SAFETY ANALYSIS REPORT FOR THE SUPER KUKLA PROMPT BURST REACTOR. W. S. Gilbert, F. A. Kloverstrom, and F. Rienecker, Jr. (California. Univ., Livermore. Lawrence Radiation Lab.). Feb. 4, 1964. Contract W-7405-eng-48. 53p.

The all-metal reactor, scheduled for operation in June 1964, and designed for bursts of 5×10^8 fissions, will be located in a shielded containment bunker. The site (geology and climatology included), reactor, reactor complex, and control system are described; and the operational procedures and personnel are discussed.

The results of hazards calculations are also presented. (D.C.W.)

24965 SILOE SUPER SWIMMING POOL REACTOR. CONCEPTION AND REALIZATION. O. de Kervenoael. Bull. Inform. A.T.E.N. (Assoc. Tech. Energie Nucl.), No. 42, 11-22(July-Aug. 1963). (In French)

Some of the characteristics of the 10-Mw reactor are given, and the means used to overcome the cooling and activity problems associated with a swimming pool reactor of this size are described. Some of the more interesting features of the reactor, experimental layout, and building are then discussed, together with construction of the facility. (D.C.W.)

24966 CONTROL AND COMMAND EQUIPMENT OF THE REACTOR "SILOE." H. Maurice and A. Sala. Bull. Inform. A.T.E.N. (Assoc. Tech. Energie Nucl.), No. 42, 23-7(July-Aug. 1963). (In French)

The principles and features of the control and safety system of the reactor are summarized. Extensive use of transistorized circuitry is featured. (D.C.W.)

24967 THE PEGASE REACTOR. ITS REALIZATION. Bull. Inform. A.T.E.N. (Assoc. Tech. Energie Nucl.), No. 43, 2-14(Sept.-Oct. 1963). (In French)

The Pegase reactor, cooled and moderated by light water and fueled with enriched U (90%), was built to test fuel elements under radiation. The entire facility, including the reactor, building, systems, and experimental facilities (8 CO_2-cooled loops), is briefly described. Construction of the reactor is also discussed. Initial operation was in April 1963; full power (30 Mw thermal) was attained in May 1963. (D.C.W.)

24968 THE HOT CRITICAL PILE "CESAR." M. Prats and M. Megy. Bull. Inform. A.T.E.N. (Assoc. Tech. Energie Nucl.), No. 45, 25-33(Jan.-Feb. 1964). (In French)

The zero-power reactor CESAR, designed for studying fuels and graphite-moderated systems, is described. Heating is provided by CO_2 circulating through a system that includes an electric oven. Control and protection provisions are also discussed. (D.C.W.)

24969 CABRI—EXPERIMENTAL SWIMMING POOL REACTOR. R. Escrive, G. Jullien, and A. Follin-Arbelet. Bull. Inform. A.T.E.N. (Assoc. Tech. Energie Nucl.), No. 46, 33-44(Mar.-Apr. 1964). (In French)

The Cabri reactor was developed for studies of the kinetics and safety of swimming-pool reactors and of fuel element behavior in a transient regime. The reactor, building, and systems are briefly described; and its construction is discussed. The reactor was made critical in December 1963, fifteen months after construction began. (D.C.W.)

24970 TEMPERATURE MEASUREMENTS OF NEUTRONS IN THE BEAM FROM THERMAL COLUMN OF VVR-S REACTOR. Miroslav Vořišek and Dušan Babala (Inst. of Nuclear Physics, Czechoslovak Academy of Sciences, Rez). Cesk. Casopis Fys., 13: 20-7(1963). (In Czech.)

A description is given of temperature measurements of neutrons by the absorption method in a beam from the graphite thermal column of VVR-S reactor, Nuclear Research Institute, Czechoslovak Academy of Sciences. Measurement was performed in five different ways: (1) In foils as an absorber and detector, (2) Au foils, (3) foils from Dy_2O_3, (4) In foils as absorber, scintillation counter with scintillator $B_2O_3 + ZnS(Ag)$ as detector, (5) Au foils as absorber, detector the same as in the preceding case. The results of measurement at the temperature of graphite (292 ± 1)°K are as follows: (1), T = (286 ± 10)°K; (2), T = (314 ± 17)°K; (3), T = (292 ± 16)°K; (4), T = (311 ± 12)°K; (5), T = (298 ± 10)°K. The mean effective temperature of all measurements $T_{ef} = (298 \pm 6)°K$ is in good agreement with the later measurements inside graphite and with the results of theoretical calculations, and indicates that neutrons achieve thermal equilibrium with the medium in a graphite column. (auth)

24971 ON SOME INSTABILITY PHENOMENA OBSERVED IN THE OPERATION OF THE 50-kw L54M REACTOR OF CESNEF. V. Sangiust and S. Terrani (Centro Studi Nucleari E. Fermi, Milan). Energia Nucl. (Milan), 11: 177-81(Apr. 1964). (In Italian)

Some instability phenomena observed together with reactivity losses at 50 kw in the L 54 M reactor of CESNEF are described. Procedures to eliminate them are considered. (auth)

24972 THE UTILIZATION OF THE AVOGADRO RSI REACTOR AT THE SORIN NUCLEAR RESEARCH CENTRE. A. Rossi and H. Walther (SORIN, Centro Ricerche Nucleari, Saluggia, Italy). Energia Nucl. (Milan), 11: 192-204(Apr. 1964). (In Italian)

After a brief description of the irradiation facilities, the present utilization of the reactor for research problems in nuclear metallurgy and technology, radiochemistry, and physics is described. A bibliography is added for the presentation of some of the main results obtained through the use of the reactor. (L.B.S.)

24973 PLACE OF MATERIALS TESTING REACTORS IN A NUCLEAR POWER PROGRAMME. R. F. Jackson, D. R. Harris, and G. N. Walton. J. Brit. Nucl. Energy Soc., 3: 149-51(Apr. 1964).

It is suggested that MTR's have a most important and continuing role to play both in the initial conception of a new power system and in the most successful technical and economical development of its design and operation over its lifetime, including aspects of safety and reliability. The extent and nature of the MTR capacity is also considered. (L.B.S.)

24974 CONTROL RODS WITH SINTERED BORON CARBIDE FOR THE ZERO ENERGY REACTOR "ANNA." Wieslaw Gauk, Erwin Kamien'ski, and Wladyslaw Rutkowski (Inst. of Nuclear Research, Warsaw). Nukleonika, 9: 47-55(1964). (In Polish)

The chemical and physical characteristics of boron carbide, which make this material suitable for cores of regulating rods in the reactor, are described. The ground and dried powder is first cold pressed, then loaded on graphite matrices, and subsequently hot pressed. The final product is cleaned, cut, chemically polished, and sealed in aluminum tubes. It was possible to attain 96% theoretical density of the boron carbide by sintering (hot pressing) at 1700 to 2100°C under 100 to 200 kilograms/cm^2 pressure. (P.C.H.)

WASTE DISPOSAL AND PROCESSING

24975 (HW-81829) RESEARCH AND DEVELOPMENT ACTIVITIES [ON] SOLIDIFICATION OF RADIOACTIVE WASTES. Progress Report. A. M. Platt, ed. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 15, 1964. Contract AT(45-1)-1350. 26p.

Research and development activities on the solidification of radioactive residues are reported. Work is reported on the following activities: small-scale spray and pot calcination studies with actual high-level radioactive wastes, large-scale spray solidification studies with non-radioactive simulated wastes, and design and fabrication of an engineering-scale prototype for demonstration of three promising processes (pot calcination, spray solidification, and phosphate glass solidification) with actual high-level radioactive wastes. (N.W.R.)

24976 (LADC-6398) FIXATION OF ATOMIC WASTES IN INERT SOLID MATERIALS. Eric B. Fowler (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract W-7405-eng-36. 35p. (CONF-516-1)

From 19th Purdue Industrial Waste Conference, Lafayette, Ind., May 1964.

The fixation of high-level atomic wastes in inert, solid materials is discussed. The following methods of fixation and disposal are described: in-tank solidification, conversion of the waste into glasses and synthetic micas, fixation in montmorillonite clay, calcination, conversion into other ceramics, entrapment in other materials, and sorption of the radioactive nuclides on synthetic zeolites. (M.C.G.)

24977 (ORNL-TM-827) PROPOSED METHODS FOR THE REMOVAL OF MERCURY FROM RADIOACTIVE WASTE SOLUTIONS. W. E. Clark and C. L. Fitzgerald (Oak Ridge National Lab., Tenn.). Mar. 31, 1964. Contract W-7405-eng-26. 22p.

A method was developed for the removal of mercury from radioactive waste solutions prior to calcination-fixation. In this process a more active metal, such as copper or aluminum, is used to displace the mercury. A batch operation is possible in which the column is simply discarded upon breakthrough, or a continuous process in which the metal is added through the top of the column as it is needed. The amalgam formed would be removed at the bottom of the column. A vibrated column filled with copper shot appeared best for FTW-65 Purex waste, and, in principle, for all waste solutions with an acidity lower than about 1.0M. Aluminum may be used for column packing with Purex waste solutions containing up to 1.5M free acid but lower acidities are required for TBP-25 (aluminum) wastes. Anodization of the copper prolonged the effective life of the column, but it was considered questionable whether the increase warrants the added complexity of design. The number of equivalents of copper dissolved per equivalent of mercury removed ranged from about 16 to about 25.5. The presence of copper should cause no difficulty in the calcination-fixation of the treated waste solution. The composition of the copper amalgam formed was not determined, but the product was a thixotropic liquid, which flowed through a glass stopcock at the bottom of the column. This indicates a probable copper content of 6% or less by weight. (auth)

24978 (ORNL-TM-851) MANAGEMENT OF FISSION PRODUCT TRITIUM IN FUEL PROCESSING WASTES. J. O. Blomeke (Oak Ridge National Lab., Tenn.). May 4, 1964. Contract W-7405-eng-26. 13p.

Tritium, a fission product of very low yield, may merit special consideration from the standpoint of its management in wastes from fuel processing. In the case of present solvent extraction plants, at least 75% of the tritium in the irradiated fuel is discharged to the environment in low-level aqueous wastes. Future plants situated less remotely may be restricted in the quantity they can release to their immediate environs. It was estimated that, under present regulations, relatively little tritium could be released to surface streams, but plants processing fuel at rates equivalent to as much as 100,000 thermal megawatts of reactor power might disperse the tritium safely to the atmosphere. Larger plants must consider containment of the tritium by internal recycle of aqueous streams. (auth)

24979 (EURAEC-202) RESEARCH PROGRAM ON WATER TREATMENT AND RADIOACTIVE RESIDUES. Quarterly Report No. 5, April–June 1961. S. A. Belchim (Societe Belge de Chimie Nucleaire, Brussels). Aug. 1961. Work Performed under United States–Euratom Joint Research and Development Program. 21p. (R-2021). (A translation)

A tracer technique using iodine-131 for measuring the water movements in the underground water-level is being evaluated. Copper rods, sunk into the ground at a known depth and distance from the point of injection, are used as absorbant. The studies of bitumen coating for radioactive residues are investigated, particularly with the aim of finding other types of bitumen and to determine the activity losses through volatilization. The latter are in the region of 10^{-3}% of the insolubilized radioactivity. The construction of the incinerator continues. The study of gas scrubbing by injecting an absorbant is continuing. Decontamination factors of 100 to 200 are achieved. (N.W.R.)

24980 (EURAEC-300) RESEARCH ON THE PROCESSING OF RADIOACTIVE WATER AND RESIDUES. Quarterly Report No. 8, January 15–March 31, 1962. (Société Belge de Chimie Nucleaire, Brussels). Work Performed under United States–Euratom Joint Research and Development Program. Contract 048-61-4-RDB. 32p. (R-2113). (A translation)

The elutriation tests of sediments, ashes, and evaporator concentrates with bitumen are evaluated. The climatic data of the Mol site are analyzed in respect of their hydrological aspect. This study has shown that the speed of infiltration of water in the upper layers of the soil may vary from 2.60 to 0.40 m per day, depending upon the degree of humidification of the section. The studies of the unsaturated zone have demonstrated that the infiltration of water in a section gives rise to a mixture between the water already in the soil and the water added. The infiltration of the water takes place by preferential routes and the isotope retention is more marked in the unsaturated medium. The apparatus for the injection of radioisotopes is completed. The groundwater sampling apparatus and the hydraulic model are being prepared. The physico-chemical studies of the ionic occupation of clays and the fixation parameters of sand are evaluated. The fixation parameters of the radioisotopes strontium-89 and cesium-134 are determined. Several incineration tests are being made for the purpose of adapting the incinerator to radioactive waste processing. (N.W.R.)

24981 ON THE DECONTAMINATION OF RADIOACTIVE WASTE WATER BY FERRIC HYDROXIDE FLOCCULATION. [PART] II. Takashi Matsumura, Toshio Ishiyama, and Tetsuo Mamuro. Ann. Rept. Radiation Center Osaka Prefect., 4: 24-7(1963).

The decontamination properties of ferric hydroxide flocculation at high concentration of foreign matter were investigated. It was found that the removal of Sr was effectively raised by the addition of equivalent or more amount of carbonate ion when the waste water to be decontaminated contained alkaline earth metal ions. No noticeable difference was found between the flocculations in a beaker and in a flocculator under the same flocculation conditions. The main role of a slurry circulation-type flocculator in the decontamination of radioactive waste water is to clarify the effluent by dynamical separation of solid from liquid. (P.C.H.)

24982 HUMIC ACID AS COAGULATION AGENT FOR CALCIUM PHOSPHATE FLOCCULATION. Takashi Matsumura, Toshio Ishiyama, and Tesuo Mamuro. Ann. Rept. Radiation Center Osaka Prefect., 4: 28-30(1963).

The effectiveness of humic acid in supplementing phosphate flocculation was investigated. The removal of ^{137}Cs and ^{106}Ru-^{106}Rh was increased by the addition of humic acid; ^{137}Cs by about 25 to 40%. The removal of ^{89}Sr increased with decrease in the ratio $Na_3PO_4 \cdot 12H_2O/Ca(OH)_2$, reaching 95.1% at the ratio 1 when 200 ppm of humic acid was added. The removal of ^{95}Zr-^{95}Nb was increased by about 10% by the addition of humic acid, and ^{144}Ce-^{144}Pr was completely removed. However, the removals of various radioisotopes were somewhat lower in calcium humate flocculation than humic acid-calcium phosphate flocculation. (P.C.H.)

24983 DECONTAMINATION OF RADIOACTIVE RUTHENIUM BY CELLULOSE DERIVATIVE-BENTONITE FLOCCULATION. [PART] I. Toshio Ishiyama, Takashi Matsumura, and Tetsuo Mamuro. Ann. Rept. Radiation Center Osaka Prefect., 4: 31-5(1963).

The possibility of using cellulose ion exchange as a flocculation agent was investigated. Two kinds of cellulose ion exchangers were synthesized from powdered cotton cellulose. They were used as flocculation agent for bentonite-polyelectrolyte flocculation and their effect on the decontamination of trivalent Ru was investigated. It was found that weak basic cellulose anion exchanger has a remarkable effect on the removal of trivalent Ru. The experimental method is outlined. (P.C.H.)

24984 DEWATERING PROPERTY OF A RADIOACTIVE SLUDGE CONCENTRATOR. Tetsuo Mamuro, Toshio Ishiyama, and Takashi Matsumura. Ann. Rept. Radiation Center Osaka Prefect., 4: 36-41(1963).

The dewatering property of a small radioactive sludge concentrator was investigated. The plant adopts the freezing treatment for concentrating the radioactive chemical sludges that are produced in the treatment of radioactive waste waters through flocculation. The plant can handle 125 l of sludge/day and can reduce the final volume of the concentrated sludge to about $^1/_{3000}$, $^1/_{2000}$, and $^1/_{4000}$ of the volume of the original waste water to be decontaminated, for bentonite-Konan Floc sludge, calcium phosphate sludge, and ferric hydroxide sludge, respectively, in the case that separation by settling is applied for the treatment after thawing. In previous beaker experiments it was found that the addition of some polymer as agent is effective in increasing the volume reduction ratio or in shortening the settling time after thawing. This finding was applied to the large-scale treatment, and good results were obtained. (P.C.H.)

24985 LIQUID RADIOACTIVE WASTE DISPOSAL AT THE PRETORIA GENERAL HOSPITAL. D. J. Savage, J. Karbendam, P. N. Swanepoel, and T. Fichardt (Pretoria General Hospital). S. African J. Radiol., 2: 11-15(Mar. 21, 1964).

An automatic system is described for the safe disposal of liquid radioactive waste from a radiotherapy institution that is entitled to discharge as much as 5 C of radioactive waste per month. The system operates on the principle of dilution and storage, in three 25,000-gal. retention tanks operating in rotation, until the radioactivity has reached a concentration in the tank ready for discharge that is low enough for discharge into a municipal sewer. (auth)

24986 AN INEXPENSIVE METHOD OF REDUCING THE VOLUME LOW LEVEL RADIOACTIVE SOLUTIONS FOR WASTE DISPOSAL. E. M. Romney, K. A. Flygare, and L. B. Silverman (Univ. of California, Los Angeles). Soil Sci. Soc. Am. Proc., 28: 295-6(Mar.-Apr. 1964).

An inexpensive, practical, and safe nonboiling method is described for evaporating radioactive nutrient solutions to small volume for subsequent waste disposal. The device is an electric immersion heater designed to float at the surface of the liquid waste. Economy, speed, and limitations of the method are discussed. (H.M.G.)

GENERAL AND MISCELLANEOUS

24987 (AEEW-M-426) GRAPHICAL REPRESENTATION OF DATA IN THE ALDERMASTON AND WINFRITH NUCLEAR DATA LIBRARY. D. C. King (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Mar. 1964. 10p.

The program GROD, in FORTRAN for the IBM 7030, produces graphs of the data stored on magnetic tape and/or punched cards in tabular form. The graphs are produced on 35 mm film or within frames 24 cm^2 on rolls of photorecording paper by a high-speed microfilm recorder. Input and output are discussed, and reproductions of output are included. (D.C.W.)

24988 (BMI-1665(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING FEBRUARY 1964. Russell W. Dayton and Ronald F. Dickerson (Battelle Memorial Inst., Columbus, Ohio). Mar. 1, 1964. Contract W-7405-eng-92. 59p.

Progress is reported on developments relating to civilian applications in reactor materials and components, fuel element fabrication and development, coatings for reactor fuels, fission product diffusion, radiation chemistry of organic compounds, and fuel burnup and feasibility. (N.W.R.)

24989 (BNL-7034) THE CRYSTAL STRUCTURE OF FERROELECTRIC LITHIUM HYDRAZINIUM SULFATE. Jan H. Van den Hende (Esso Research and Engineering Co., Linden, N. J.) and Henri Boutin (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract [AT(30-2)-Gen-16]. 22p.

Crystals of lithium hydrazinium sulfate were found to be orthorhombic with cell dimensions a = 9.913, b = 8.969, and c = 5.178 Å. They were ferroelectric. The space group was P na 2, with four formula units in the unit cell. The crystal structure was determined by using the heavy-ion method from 0kl, h0l, and hk0 data. Bond lengths and angles based on three-dimensional data are given. The N-N distance found was 1.447Å. The nitrogens formed, in the direction of the c-axis, an infinite hydrogen-bonded zig-zag chain of the type NH–N with a distance of 3.018Å. The length of one of the S-0 was 1.557Å. The structure was held together by a three-dimensional network of very weak hydrogen bonds. Tentative positions of the hydrogens were assigned. (auth)

24990 (IS-842) A TABLE OF SIN$^2\theta$ VERSUS θ AND 2θ. Frank S. Carlsen (Ames Lab., Ames, Iowa). Mar. 1964. Contract W-7405-eng-82. 42p.

A table of $\sin^2\theta$ vs θ and 2θ for θ from 0. to 89.995 degrees in increments of 0.005 degree is presented. The methods of computation and checking of the results are also discussed. (auth)

24991 (IS-884) THE TREATMENT OF A CESIUM ORE BY SULFUR CHLORIDE AND CHLORINE. C. B. Hamilton, T. L. Young, and H. A. Wilhelm (Ames Lab., Ames, Iowa). [Apr. 1964]. Contract [W-7405-eng-82]. 21p. (CONF-513-1)

From the Iowa Academy of Sciences, Decorah, Iowa, Apr. 1964.

A Southern Rhodesian cesium ore containing primarily pollucite was chlorinated by a gaseous mixture of sulfur chloride and chlorine at temperatures between 550 and 700°C. The reaction products consisted principally of $SiCl_4$, $AlCl_3$, CsCl, and CsCl · $AlCl_3$. Under favorable conditions for chlorination, 17 wt % of the ore remained unreacted. The optimum conditions with the fixed bed reactor used in this study were chlorination at 650°C for 4½ hr with an ore particle size that passes a 150 mesh sieve. (auth)

24992 (IS-904) CONSEQUENT PROCEDURES IN CONVENTION COMPUTERS. D. R. Fitzwater (Ames Lab., Ames, Iowa) and E. J. Schweppe (Maryland. Univ., College Park). [1963]. Contract [W-7405-eng-82]. 36p. (CONF-518-1)

For Presentation at the Fall Joint Computer Conference, San Francisco, Oct. 1964.

The use of consequent procedures in designing programming systems and languages for real time, on-line or multiprogramming applications is discussed. Consequent procedures differ from normal procedures in that the flow of control between procedures is defined by the consequences of previous procedure rather than the programmer. The use of these concepts leads to comparatively simple system and language design for general purpose systems. Interactions with the external world of human and nonhuman users are simply described and implemented. (auth)

24993 (KAPL-M-6139) MATHEMATICAL PROGRAMS AVAILABLE ON THE PHILCO-2000 COMPUTER. PART 1. INTERPOLATION, INTEGRATION, AND CURVE FITTING. Gerhard O. Mueller (Knolls Atomic Power Lab., Schenectady, N. Y.). Mar. 13, 1964. Contract W-31-109-eng-52. 34p.

The interpolation, integration, and curve fitting methods used at Knolls Atomic Power Laboratory and programmed for the Philco 2000 are summarized. (auth)

24994 (MND-2531-1) INVESTIGATION OF ALLOTROPIC TRANSFORMATION IN METALS. Final Report, March 1, 1960–March 1, 1964. Henry M. Otte (RIAS. Div. of Martin Co., Baltimore). Contract AT(30-1)-2531. 95p.

A method is presented for determining the orientation of rhombohedral and cubic crystals from the angles between traces produced on a single surface of a specimen by three crystallographically equivalent planes. Results are tabulated for the case of traces produced by $\{11\bar{1}\}$ planes in Hg crystals. The problem of determining the thickness and orientation of a thin crystalline foil from measured angles between surface traces on a transmission electron micrograph and the projected widths of these traces is examined. Methods useful for discarding superfluous solutions to this problem are introduced. The resolution of the lattice-invariant shear, associated with the formation of plates of martensite, into two component shears and a rotation is examined. Particular attention is given to the martensite reaction in steels. (T.F.H.)

24995 (NAA-SR-8888) ANNUAL TECHNICAL PROGRESS REPORT. AEC UNCLASSIFIED PROGRAMS, FISCAL YEAR 1963. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 1, 1964. Contract AT-11-1-GEN-8. 380p.

Separate abstracts were prepared for the 6 sections including advanced sodium-cooled reactors, research and development of Hallam Nuclear Power Facility, advanced organic-moderated reactors, reactor safety, separations chemistry, and the advanced development program of NAA(AI). (R.E.U.)

For abstracts of individual papers see: 23701, 24816, 24891, 24892, 24893, and 24996.

24996 (NAA-SR-8888(Sect.VI)) ADVANCED DEVELOPMENT PROGRAM. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). 85p.

Topics covered include reactor physics studies, fission effects in metal fuels, structure, properties, and fission effects in UC and other refractory interstitial fuels, study of BeO as a reactor material, high-temperature chemistry, radiation chemistry, electronic structure of metals and alloys, and radiation damage in crystalline solids. Fission-neutron age calculations are reviewed for water, diphenyl, graphite, and water-metal mixtures. Fission effects were studied in U–Mo, U–Mo–Si, and U–Mo–Sn alloys. Fused salts and metal-metal salt solutions were studied at high temperatures. The heats of vaporization of nonionic liquids and alkali halides were calculated. Heats of fusion of rare gases and alkali halides were calculated. The melting point and volume of fusion of $LiNO_3$, $NaNO_3$, and KNO_3 under pressure were investigated. Electrical conductivities of molten Bi–$BiBr_3$ solutions were measured. Free energies of interaction were calculated for metal-metal salts of Li, Na, K, Rb, Ag, Tl, Mg, Ca, Sr, Ba, Zn, Cd, Hg, Al, Ga, La, Ce, Nd, Ni, U, Sn, Pb, Sb, and Bi. The mechanisms of radiolysis of organic systems were studied; included are tritium β-decay induced reactions in polystyrene fluff, interconversion of acetone and isopropanol, pyrolysis of deuterated toluenes, radiolysis of cyclohexane-t and benzene-carbon-14 mixtures, reactions of deuterated polystyrenes with hydrogen and deuterium atoms, isomerization of cis-2 butene as a detector for triplet states in irradiated hydrocarbons, radioiodined exchange of acetone and propanol-2, ESR of photolysis of iodobenzene at 77°K, and radiolysis of cyclohexane-cyclohexene solutions. Radiation damage was studied in Al, Au, Cu, Ag, bcc metals, and semiconductors at low temperatures for electron irradiation. (R.E.U.)

24997 (NYO-3046-1) BASES FOR GENETIC STUDIES IN BLUE-GREEN ALGAE. (Rochester, N. Y. Univ.). [1964]. Contract AT(30-1)-3046. 74p.

Basic cultural and experimental techniques are described that were used in genetic studies in blue-green algae. Classical investigative techniques were supplemented by measurements of 2000 spores and culture of dried herbarium specimens of the selected strain. The effects of various chemical algicides and herbicides, NaCl, $CuSO_4$, streptomycin, penicillin, ultraviolet radiation, and β particles from ^{32}P incorporated in the medium on growth and genetic structure were studied. Emphasis was placed on studies of Anaboena cylindrica, with A. oscillariodes, the type species of the genus, discussed in detail. Elucidation of the genetic system of blue-green algae is discussed and a list of culture strains is included. (64 references). (C.H.)

24998 (ORNL-3595) AN AUTORADIOGRAPHIC AND HISTOLOGIC STUDY OF SPLEEN WHITE PULP GERMINAL CENTERS DURING EARLY INTERVALS OF THE PRIMARY IMMUNE RESPONSE (thesis). M. G. Hanna, Jr. (Oak Ridge National Lab., Tenn.). May 1964. Contract W-7405-eng-26. 106p.

Submitted to Univ. of Tennessee.

Autoradiographic studies using tritiated thymidine were performed on germinal centers in the spleens of primary sheep-red-blood-cell (SRBC)-stimulated mice during the first 48 hr after intravenous injection. Mean grain counts and the percentage of labeled cells were determined for cells located in the densely populated and thinly populated regions of the germinal centers. Mean grain counts were also made on the morphologically identical cells dispersed throughout the lymphocyte mass associated with the germinal centers. Histological investigations were also performed on the lymphatic tissue and germinal centers of the mouse spleen with concurrent measurements of cellular changes in the peripheral blood during the first 4 days after a primary SRBC stimulation. The fate of primitive lymphatic tissue cells during early intervals of the primary immune response was interpreted from spleen imprint autoradiograms. Data are presented on the quantitative and histologic aspects of germinal center dissociation and the migration and fate of germinal center cells in the spleen of normal and antigenically stimulated animals during the primary immune response and concurrent cellular changes in the peripheral blood. (67 references.) (C.H.)

24999 (RM-3953-AEC) EFFECT OF COMPRESSIBILITY ON THE STABILITY OF A FLUID INTERFACE. Milton S. Plesset (RAND Corp., Santa Monica, Calif.). Apr. 1964. Contract AT(04-3)-414. 14p.

The stability of the interface between two fluids was studied, taking into account the compressibility of the fluids. The essential feature of the calculation was contained in a transformation from the original coordinate system (x,y) to a new coordinate system (x^1,y) with a Galilean transformation, $x^1 = x - (n/\sigma)t$, $y^1 = y$, which brings the wave disturbance to rest. Calculations are presented for both the supersonic and subsonic cases. (M.C.G.)

25000 (RPI-1999-3) NON-AQUEOUS SILVER NITRATE SOLUTIONS: ELECTRICAL CONDUCTANCE AND VISCOSITY IN ACETONITRILE AND BENZONITRILE. Technical Report No. 13. George J. Janz, A. E. Marcinkowsky, and Iqbal Ahmad (Rensselaer Polytechnic Inst., Troy, N. Y.). Apr. 1964. Contract AT(30-1)-1999. 16p.

The electrical conductance, viscosity and density of silver nitrate solutions in anhydrous acetonitrile and benzonitrile in the concentration range up to 6 molar at 25°C were measured. The Bjerrum and Fuoss-Kraus criteria for ionic aggregates clearly confirm the formation of ion-pairs as the concentration increases from the dilute range, with evidence for higher aggregates (triple-ions) with further concentration increase. The partial molar volume data support the view that CH_3CN has a more open solvent structure than either C_6H_5CN or H_2O. The solvation interactions and the equivalent conductances are examined from current semi-empirical viewpoints and discussed relative to aqueous solutions of comparable $AgNO_3$ concentrations. (auth)

25001 (SC-DC-64-459) EARTH RESISTANCE TO PROJECTILE IMPACT. First Quarterly Progress Report, PR-53. James R. Barton and L. J. Thompson (New Mexico. Univ., Albuquerque. Engineering Experiment Station). Mar. 1964. For Sandia Corp., Albuquerque, N. Mex. Contract AT(29-1)-789. 28p.

Theoretical studies of the penetration of cylindrical projectiles into gelatin targets are reported. The projectile is assumed to have velocity in the axial direction only. (T.F.H.)

25002 (SC-TM-64-8) AN ERROR ANALYSIS OF A TWO-COMPONENT STRAIN-GAGE BALANCE. J. K.

Cole (Sandia Lab., Albuquerque, N. Mex.). Feb. 1964. Contract AT(29-1)-789. 18p.

An error analysis was made of a simple, two-component, strain-gage balance. This type of strain-gage balance is commonly used to determine the normal force and center of pressure of a model being tested in a wind tunnel. The analysis established the explicit relations between the errors in the calculated normal force magnitude and the center of pressure as functions of the errors in the calibration constants and the actual center-of-pressure location relative to the balance. The results indicated that very large errors in the calculated normal force and center of pressure may occur when the actual center of pressure is not located between the strain-gage stations. Graphs are presented, which show the magnitude of these errors as a function of the center-of-pressure location for ±1-percent errors in the balance calibration constants. (auth)

25003 (STI/DOC/10/25) IAEA LABORATORY ACTIVITIES. The IAEA Laboratory at Vienna and Seibersdorf. The Marine Biological Project at Monaco. The Middle Eastern Regional Radioisotope Centre for the Arab Countries, Cairo. First Report. Technical Reports Series No. 25. (International Atomic Energy Agency, Vienna). 1964. 111p.

Separate abstracts were prepared for three sections of this report. (C.H.)

For abstracts of individual sections see: 23167, 23168, and 25004.

25004 (STI/DOC/10/25(p.9-69)) THE IAEA LABORATORY AT VIENNA AND SEIBERSDORF. (International Atomic Energy Agency, Vienna).

Activities during 1963 included the calibration of radiation sources and dosimeters; the establishment of international standards of radiometric analysis; the radiochemical analysis of uranium ores, fuel elements, and reactor materials; studies of soil properties and the development of tracer techniques for use in agricultural studies; the development of instruments and techniques for use in medical research, with emphasis on whole-body counters, the standardization of techniques for thyroid ^{131}I measurements, and the standardization of methods for the investigation of the effects of thorium in persons using luminous dial paints containing Thorotrast; and the development of methods using tritium as a tracer in hydrological studies. (C.H.)

25005 (TID-4043(Rev.1)) INDEX TO CONFERENCES RELATING TO NUCLEAR SCIENCE. Willie E. Clark, Alden G. Greene, and Margaret L. Pflueger, eds. (Division of Technical Information Extension, AEC). May 1964. 132p.

An index is presented to conferences listed in the subject indexes of *Nuclear Science Abstracts* Vol. 11 through 17 (1957 – 1963), under the heading Conferences and in the announcement series, *Availability of Nuclear Science Conferences Literature*, TID-19000, numbers 1 through 4. Access to the information is provided by date, place, conference number, report number, and significant words in the titles. (C.H.)

25006 (TID-18927) THE EXCRETION OF TAURINE-S^{35} AND SULFATE-S^{35} IN ADRENALECTOMIZED RATS TREATED WITH TWO CORTICOIDS. E. Irene Pentz (Chicago Wesley Memorial Hospital). [nd]. Contract AT(11-1)-789. 21p.

Taurine excretion levels of sham-operated and adrenalectomized female Sprague-Dawley rats maintained on three different commercial laboratory animal diets were determined. No significant difference in taurine excretion was found among the three diets. Sham-operated and adrenalectomized rats given a tracer dose of methionine-^{35}S excrete taurine-^{35}S having a specific activity significantly different from each other. The administration of Decadron to adrenalectomized rats that have been given a tracer dose of methionine-^{35}S results in the excretion of taurine-^{35}S having a specific activity which is not significantly different from sham-operated controls. The specific activity of sulfate-^{35}S excreted by sham-operated and adrenalectomized rats differs significantly. Administration of Florinef to adrenalectomized rats returns the specific activity of the excreted sulfate-^{35}S to normal. Administration of Decadron to adrenalectomized rats having a tracer dose of methionine-^{35}S does not, at the dosage level employed here, influence the specific activity of the excreted sulfate. Decadron and Florinef elicit their effects on the metabolism of methionine at different points in its oxidation. (auth)

25007 (TID-18929) ADAPTION OF A METHOD FOR THE DETERMINATION OF TAURINE IN URINE TO THE AUTOANALYZER. E. Irene Pentz (Chicago Wesley Memorial Hospital). [nd]. Contract AT(11-1)-789. 17p.

Taurine is determined in urine by first diluting with phthalate buffer, pH 4.5, and triturating with Dowex 50, H$^+$ ion form, followed by filtration, to remove interfering amino acids and other substances. The filtrate was introduced into the Autoanalyzer where it was reacted with dinitrofluorobenzene, neutralized, extracted with chloroform or carbon tetrachloride, and the aqueous phase delivered to the colorimeter. Satisfactory standard curve determinations were obtained over the range of 6 to 84 μg/ml of taurine. The method may also be used without the extraction in which case about one-half of the sensitivity is lost. (auth)

25008 (TID-19032) ELECTRON MICROSCOPIC STUDIES OF ISOLATED MAMMALIAN CHROMOSOMES. Arthur Cole (Texas. Univ., Houston. M. D. Anderson Hospital and Tumor Inst.). [1963]. Contract AT(40-1)-2832. 23p.

Procedures are described for electron microscopic studies of intact metaphase chromosomes isolated from Chinese hamster cells in culture. Observations on chromosome structure during metaphase are reported. (C.H.)

25009 (TID-19079) STUDIES ON THE ACTIVATION AND INACTIVATION OF LIVER *p*-HYDROXYPHENYLPYRUVIC ACID OXIDASE. Mahendra N. D. Goswami (New England Deaconess Hospital. Cancer Research Inst., Boston). [July 18, 1963]. Contract [AT(30-1)-901]. 35p.

Active liver *p*-hydroxyphenylpyruvic acid oxidase (pHPP oxidase) is reversibly inactivated by nonspecific procedures, such as dialysis, ammonium sulfate fractionation, and prolonged storage simulating the inactivation that occurs *in vivo* in the guinea pig fed L-tyrosine. Similar reversible inactivation of the enzyme can be produced by oxidizing agents. The inactive pHPP oxidase is reactivated by GSH plus DCPP and other reductants. The enzyme activity was inhibited by various chelating agents. While 1,10-phenanthroline and bathophenanthroline (Fe^{++} selective) strongly inhibited, neocuproine (Cu$^+$ specific) did not. The 1,10-phenanthroline-treated pHPP oxidase was reactivated specifically by Fe^{++} in the presence of reducing agent, indicating a role for Fe^{++} in pHPP oxidase activity. Inhibition analysis with sulfhydryl reagents did not indicate direct involvement of a free (SH)-group in the reversible inactivation of pHPP oxidase. Reversible inactivation which could be due to oxidation of enzyme-bound ferrous iron is discussed in the light of present findings. (auth)

25010 (TID-19257) DEVELOPMENTAL DEFORMITIES POSSIBLY DUE TO THALIDOMIDE. A Case Report. Y. Ihno and W. J. Russell (Atomic Bomb Casualty Commission, Hiroshima). [May 15, 1963]. Contract [AT(49-1)-Gen-72]. 7p.

A few of the salient features in the history of development of malformations in infants attributable to ingestion of Thalidomide by mothers during pregnancy are reviewed. A report of a case is made in which deformities of the hands and possible congenital heart disease may be due to this medication. An additional consideration is the fact that the infant's father experienced the atomic bombing of Hiroshima. (auth)

25011 (TID-20348) AMINO ACIDS OR SMALL PEPTIDES AS PUNCTUATION IN THE GENETIC CODE OF DNA. A. Bendich, E. Borenfreund, G. C. Korngold, M. M. Krim, and M. E. Balis (Sloan-Kettering Inst. for Cancer Research, New York *and* Cornell Univ., New York. Medical Coll.). [1963]. Contract AT(30-1)-910. 32p. (CONF-528-1)

From the Nucleic Acids and Their Role in Biology, Milan, Sept. 1963.

Desoxyribonucleic acid was isolated from spermatozoa and other sources, and studies were made of amino acid composition and other properties. Data are presented from studies of the biological effects of a number of chemical carcinogens and anti-tumor agents on chromosomes, DNA molecules, and enzyme systems. It is postulated that small peptide linkers may serve to delineate the beginnings and ends of cistron units that contain genetic messages in DNA. This would imply an ordered sequence of genetic messages in the genetic code of polyfunctional DNA. (auth)

25012 (TID-20579) THE APPLICATION OF TIME-LAG MODELS TO NATURAL POPULATIONS. P. J. Wangersky and W. J. Cunningham (Yale Univ., New Haven. Bingham Oceanographic Lab. *and* Yale Univ., New Haven. Dunham Lab. of Electrical Engineering). [1962]. Contract AT(30-1)-1349. 31p.

A mathematical model based largely on physiologically determined quantities was applied to several species in order to predict the pattern of growth of the population. Population growth curves were predicted for a wide range of animal sizes with information available on survivorship and on the effects of population density on the growth of the population. These include the vicuna, *Vicugna vicugna*; the ringed seal, *Phoca hispida* and the bearded seal, *Erignathus barbatus*; the copperhead snake, *Agkistrodon cupreus*; the song sparrow, *Melospiza melodia*; two species of ectoparasites on the California red scale, *Aphytis lingnanensis* and *A. chrysomphali*; the blacktail prairie dog, *Cynomis ludovicianus*; the prairie vole, *Microtus ochrogaster*; and man. The models could also be used to evaluate the effects of environmental changes on the growth of the populations. (C.H.)

25013 (TID-20612) ON A DYE DIFFUSION EXPERIMENT OFF LONG ISLAND. Takashi Ichiye (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory). May 1964. 36p. (CU-9-64-Nonr-266(48); CU-10-64-30-1-2663).

Dye diffusion experiments are described that were made on September 11 and 12, 1963, 30 miles south of Long Island. Ten gallons of Rhodamine B dye were pumped at three depths (0, 3, and 7m) in the water each day. On the first day, the dye patch showed a curved pattern and dye was diffused only above 10 m, perhaps due to rather calm weather conditions. On the second day, the dye patch was elongated but did not show a remarkable curvature; also, dye penetrated into deeper than 70 m, owing to strong mixing caused by winds of 15 to 20 knots. A mathematical model is appended of wind-driven currents in the ocean with a finite depth for eddy viscosity decreasing exponentially with depth. It is shown that the hodograph of the currents has a stronger curvature near the surface for eddy viscosity decreasing downwards than the ordinary Ekman spiral for a constant eddy viscosity. The study of three-dimensional structure of wind waves is reviewed and a hydrodynamic model of a stationary cellular convection superposed on a horizontal current is discussed. (C.H.)

25014 (UCRL-7312) "EQUIPOTENTIAL" ZONING OF TWO-DIMENSIONAL MESHES. Alan M. Winslow (California. Univ., Livermore. Lawrence Radiation Lab.). June 5, 1963. Contract W-7405-eng-48. 26p.

A computer method is described for smoothly and automatically zoning the interior of a two-dimensional region of arbitrary shape. The mesh lines are regarded as two intersecting sets of equipotentials, each set satisfying Laplace's equation in the interior of the region and boundary conditions determined by the boundary zoning. The difference equations for the intersection points are solved by iteration. Solutions converge rapidly, despite the fact that negative weights may appear. Applications are made to triangle and quadrilateral meshes. The method can also be applied to the solution of two-dimensional potential problems. Since it locates equipotentials directly, it has the advantage of automatically adjusting the coordinate spacing to the spacing of the equipotentials. (auth)

25015 (UCRL-7359) O-RING SEALS AT HIGH PRESSURE. F. H. Miars (California. Univ., Livermore. Lawrence Radiation Lab.). June 6, 1963. Contract W-7405-eng-48. 13p.

The use of O-ring seals in high-pressure static applications up to 200,000 psi is discussed. Design types for high-pressure work are described. (M.C.G.)

25016 (UCRL-7373) SOME ISOMERS OF CHLOROIODOTRIFLUOROETHANE. Eugene R. Bissell (California. Univ., Livermore. Lawrence Radiation Lab.). June 8, 1963. Contract W-7405-eng-48. 11p.

A study was made of the addition of iodine monochloride to trifluoroethylene in both the presence and absence of a liquid phase. The effects of ultraviolet light and various metal chloride catalysts on the reaction and reaction products were determined. One of these catalysts led to the synthesis of a third chloroiodotrifluoroethane isomer, 1-chloro-1-iodo-2,2,2-trifluoroethane. Iron, tin, and aluminum chlorides were used as catalysts, with aluminum chloride the catalyst with which the new isomer was formed. (M.C.G.)

25017 (UCRL-7405) A HIGH-TEMPERATURE OPTICAL EXTENSOMETER. T. Anderson (California. Univ., Livermore. Lawrence Radiation Lab.). May 16, 1963. Contract W-7405-eng-48. 12p.

An instrument for measuring and recording creep in test specimens under tension at incandescent temperatures is described. The design was optimized for operation in the 3500°F range. An optical train is used to present an aerial image of two fiducial markers on the specimen to the measuring and recording system. An oscillating spectrometer slit senses the instantaneous position of the markers and triggers an optical linear measuring sequence, which can be fed into electronic recorders. A transmission grating with 1000 lines per inch is used to generate the measuring pulse. Operation is continuous and automatic. Some design details are presented. (auth)

25018 (UCRL-7750) RECOMMENDED CRATER NOMENCLATURE. Spenst M. Hansen, Milo D. Nordyke, Donald E. Rawson, Walter C. Sherman, Joseph L. Spruill, William L. Steinriede, and John Toman (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 16, 1964. Contract W-7405-eng-48. 4p.

A system is proposed for the formulation of a unified system of crater nomenclature. An effort was made to formulate both notation and terminology which will have practical use in the study and representation of nuclear and high explosive craters, and which will provide a basis for an orderly expansion of the nomenclature as becomes necessary in the future. (C.H.)

25019 (UCRL-10823) EXCESS-KINETIC-ENERGY IONS IN ORGANIC MASS SPECTRA. I. KINETIC ENERGIES, APPEARANCE POTENTIALS, AND THE MECHANISM OF FORMATION. John Olmsted, III, K. Street, Jr., and Amos S. Newton (California. Univ., Berkeley. Lawrence Radiation Lab.). May 1963. Contract W-7405-eng-48. 33p.

The characteristics of excess-kinetic-energy ions in mass spectra were studied with a Dempster type mass spectrometer. Measurements were made of the amount of kinetic energy possessed by both thermal and excess-kinetic-energy methyl ions from a large variety of organic compounds. In addition, the appearance potentials of excess-kinetic-energy methyl ions were determined for several compounds. Analysis of these data in conjunction with similar information obtained for some fragments other than methyl ions showed that the major source of excess-kinetic-energy ions is not doubly charged ions as previously supposed, but dissociative excited states of singly charged ions. The appearance potential curves for excess-kinetic-energy ions in the threshold region were observed to vary as the second power of the excess energy of the bombarding electrons. Existing theory of threshold behavior of ions formed by electron impact was modified to bring the theory into agreement with this observation. (auth)

25020 (UCRL-10832) THE CRYSTAL STRUCTURE AND HYDROGEN BONDING OF MAGNESIUM SULFATE HEXAHYDRATE. Allan Zalkin, Helena Ruben, and David H. Templeton (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry). May 1963. Contract W-7405-eng-48. 18p.

Crystals of $MgSO_4 \cdot 6H_2O$ were found to be monoclinic, space group C2/c with 8 formula units in the unit cell with dimensions a = 10.110, b = 7.212, c = 24.41 Å, and β = 98.30°. The atomic parameters were refined by least squares using x-ray counter data for 2576 independent reflections. The positions of the hydrogen atoms found by least squares and by Fourier methods confirmed the assignment of hydrogen bonds made previously for the isomorphous $CoSO_4 \cdot 6H_2O$. Average interatomic distances were: water coordinated to Mg, Mg–O = 2.06 Å; hydrogen bonds, O–O = 2.82 Å; sulfate ion S–O = 1.473 Å (uncorrected), 1.486 Å (corrected for thermal motion). (auth)

25021 (AEC-tr-6316) ANNUAL REPORT OF THE JAPANESE ASSOCIATION OF RADIATION RESEARCH IN POLYMERS, VOLUME 2, 1960. Translation of Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, 2: 1960. 720p.

A total of 104 papers are presented together with two summaries of the work done in the Osaka and Tokyo Laboratories. Separate abstracts were prepared for 100 of the papers. For abstracts of the four remaining papers, see NSA, 16: 30462; 17: 4613; 17: 29924; and 16: 10059. (D.L.C.)

For abstracts of individual papers see: 23397, 23398, 23399, 23401, 23581, 23582, 23583, 23584, 23585, 23586, 23587, 23588, 23589, 23590, 23591, 23592, 23593, 23594, 23595, 23596, 23597, 23598, 23599, 23600, 23601, 23602, 23603, 23604, 23605, 23606, 23607, 23608, 23609, 23610, 23611, 23612, 23613, 23614, 23615, 23616, 23617, 23618, 23619, 23620, 23621, 23622, 23623, 23624, 23625, 23626, 23627, 23628, 23629, 23630, 23631, 23632, 23633, 23634, 23635, 23636, 23637, 23638, 23639, 23640, 23641, 23642, 23643, 23644, 23645, 23646, 23647, 23648, 23649, 23650, 23651, 23652, 23653, 23654, 23655, 23656, 23657, 23658, 23659, 23660, 23893, 23894, 24148, 24149, 24197, 24198, 24199, 24217, 24218, 24219, 24220, 24250, 24251, 24626, 24627, and 24628.

25022 (ANL-Trans-15) SOME METHODS FOR THE EVALUATION OF PLASTIC LINING MATERIALS IN RELATION TO AGGRESSIVE LIQUIDS. N. S. Tikhomirova, K. I. Zernova, and V. N. Kotrelev. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Plasticheskie Massy, No. 12, 40-5(1962). 11p.

The diffusion of aggressive liquids (acids and water) into various polymers at different temperatures has been studied. A quantitative estimate of plastic lining materials by using water and acid diffusion coefficients at different concentrations has been carried out. With respect to 98% nitric acid at 50°C the most stable were the fluoroplasts (diffusion coefficient = 2.7×10^{-8} cm^2/sec) and the least stable were the vinyplast (separation into layers). A graphical method for the determination of the weight of sample in the state of equilibrium with the aggressive liquid has been proposed, which permits a considerable decrease of the testing time. The penetration rates of nitric acid (60 and 98%) into polyethylene, its mixtures with polyisobutylene at various proportions, into vinyplast and of polytrifluoroethylene have been measured. The diffusion coefficients of 98 and 60% nitric acid have been determined from their penetration rates into various materials. The proposed methods permit a single and rapid determination of the diffusion characteristics of polymers with respect to extremely aggressive liquids. (auth)

25023 (ANL-Trans-21) ON OXIDATION FERMENTS FROM HIGHER PLANTS. II. ON LIPOXIDASE AND LIPODEHYDRASE AND THEIR MUTUAL CORRELATIONS. Wilhelm Franke and Helmut Frehse. Translated by Elmar K. Wilip (Argonne National Lab., Upton, N. Y.), from Z. Physiol. Chem., 298: 1-26(1954). 30p.

Data are presented from a series of studies on oxidation ferments from higher plants. Emphasis was placed on the dehydration of saturated fatty acids by plant extracts. Data are included on the occurrence, properties, and effects of lipoxidase and lipodehydrase in seeds or plants of barley, rye, wheat, soybean, flax, hemp, pumpkin, rape, poppy, white mustard, walnut, and sunflower. (65 references). (C.H.)

25024 (ANL-Trans-24) ON THE CALCULATION OF THE PROPAGATION OF HARMONIC PERTURBATIONS IN A LIQUID WHICH FILLS SERIALLY AND PARALLELY

CONNECTED PUMP AGGREGATE PIPES. Yu. N. Grizodub. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Zh. Tekhn. Fiz., 21: 564-72(1951). 12p.

The applicability of the theory of passive quadrupoles and of the method of impedances to calculation of high-amplitude harmonic perturbations in hydraulic systems consisting of serially or parallely connected pipes or their combinations is shown. Equations for calculations for some systems of practical interest are given. (M.C.G.)

25025 (JPRS-24552) TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 82. Translated from K'o Hsueh T'ung Pao, No. 2, (1964). 91p. (OTS-64-31241)

Summaries or translations of selected papers on science and technology development in Communist China are presented. Topics covered include: formation of Oncomelania distribution areas in China from geological and geographical viewpoints, active materials which can produce optical maser action, the separation and analysis of rare earth elements by paper-phase partition chromatography, utilization of α-methoxybenzyl acetic acid as precipitant for zirconium, electron magnetic resonance spectra of V_2O_5 type of catalyst, magnetic resonance of aromatic hydrocarbon carbonium ions, quantitative titration of selenium, scientific conference of Highway Engineering Committee, and an interview with tumor specialist Professor Hsieh Chih-kuang. Separate abstracts were prepared for 2 papers. (M.C.G.)

For abstracts of individual papers see: 23415 and 23709.

25026 (JPRS-24593) TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 83. Translated from K'o Hsueh T'ung Pao, No. 2, (1964). 152p. (OTS-64-31257)

Summaries or translations of selected articles on developments in science and technology in Communist China are presented. Topics covered by the papers include: history of founding of revolutionary hospital; field experiment with "401" germicide; separation and determination of zirconium and thorium; preparation of organic material with various elements through benzene; solubility of hydroxy compounds; characteristics and laws on catalytic chromatography; $2F_{5/2} - 2F_{7/2}$ absorption spectrum of ^{14}Ce in silica and borax glass; report from the First National Conference of Electrochemistry; research on Cenozoic period; development of pedology in China; developments in ore dressing; development of agriculture, forestry, animal husbandry, subsidiary production, and fishery in China's natural regions; preparation of single crystals of calcium fluoride by zonal fusion; working parameters of ruby photon magnifier and energy output of stimulated emission; x-ray observation of substructure of ruby; determination of nature of free amino acids in early embryonic development; protective effects of streptomycin on chromosomes of reproductive cells against radiation damage in mammals; study of physiologically active substance in juice of Eleochaus tubrosa; 1963 Annual Meeting of Chinese Psychological Society; First National Wood Hydrolysis Conference; First National Mechanical Transmission Conference; and Peking Science Hall opens. A list of seminars and conferences is given and some book reviews are included. Separate abstracts were prepared for 4 of the 22 papers. (M.C.G.)

For abstracts of individual papers see: 23359, 23416, 23459, and 23460.

25027 (LA-tr-64-2) THERMAL DECOMPOSITION AND COMBUSTION PROCESSES IN EXPLOSIVES. K. K. Andrejev. Translated from Explosivstoffe, No. 12, 275-84 (1960). 29p.

Studies were made on the thermal decomposition and combustion processes in liquid and solid explosives. From the results, it was possible to draw some general conclusion about the mechanism of gradual thermal decomposition. It was established that thermal decomposition as a rule involves at least two reactions. The first sets in spontaneously and, in the case of the substances studied, is of the first order; its velocity depends only on the temperature of the substance, and is equal to its minimum possible rate of decomposition. The second reaction is self-accelerated, either autocatalytically or by some other mechanism. The substances causing the acceleration may be either final products of decomposition (water in the case of nitrate esters) or intermediate products (nitrogen dioxide in decomposition of nitrate esters). (P.C.H.)

25028 (ORNL-tr-72) FREEZING POINT DEPRESSION DUE TO ANOMALOUS CRYSTAL HABIT AS WELL AS BY LIMITATION OF THE CRYSTAL SIZE. Werner Kuhn. Translated for Oak Ridge National Lab., Tenn., from Helv. Chim. Acta, 39: 1071-86(1956). 24p.

Vapor pressure increases of crystals and the freezing point depressions corresponding to them are given for small crystals of normal habit as well as for crystals precipitated in a very thin liquid film. It was found that crystals, which partly project from the liquid, have a much greater vapor pressure increase and thus a much greater depression of the melting point than crystals completely immersed in the liquid. In the case of crystals precipitated in the interior of a gel, whose skeleton is formed by filaments of high-molecular weight materials that are cross-linked at nodes, growth inhibition by a crystal surrounded by a single molecular filament takes place. The amount by which the temperature has to be lowered below the normal freezing temperature T_0, so that the crystal will continue its growth in spite of the presence of the surrounding filament, is approximately twice the value of the freezing point depression of a micro-ice crystal of identical size, which is not surrounded by a molecular filament. (P.C.H.)

25029 (ORNL-tr-92) DIFFUSION OF INTERSTITIAL ATOMS AND EMPTY SPACES IN COPPER AT DIFFERENT TEMPERATURES. Translated from Colloq. Intern. Centre Natl. Rech. Sci. (Paris), No. 113, 125-8(1962). 8p.

The diffusion of interstitial atoms and defects in copper crystals was calculated. Results are presented in tables. It was shown that the concentration of interstitials reaches a limited value that is equal to n/(1-f), where n is the number of adjacent interstitial positions (12 for copper) and (1-f) is the fraction of interstitials dissipated in 1.80 sec. (M.C.G.)

25030 (ORNL-tr-120) HIGH-PURITY GERMANIUM—SURFACE CONDUCTION AND CARRIER LIFE. F. Aurich, H. P. Kleinknecht, A. Renz, K. Schuegraf, and K. Seiler. Translated for Oak Ridge National Lab., Tenn., from Ann. Physik (7), 11: 83-100(1963). 29p.

By means of suitable measures in the hydrolysis of $GeCl_4$ and by repeated zone refining without crucibles, germanium with an effective impurity content of less than 10^{10} cm^{-3} was prepared. Conductivity measurements in this material with various gas atmospheres and with polished and etched surfaces indicate a predominant surface conduction for the entire temperature range from 250 to 4°K. The fact that no volume conduction appears up to the lowest temperatures is explained by a poisoning of the volume by $10^{-9}-10^{10}$ impurity atoms/cm^3 with low acceptors, such as Ag or Au. Orienting Hall effect determinations show that the surface is p-conducting and that the mobility at low temperatures is smaller by one to two orders of magnitude than the volume mobility, although the latter is approached above 90°K. From the range of temperatures between 200 and 140°K, the density of the surface acceptors ($\approx 2 \cdot 10^{13}$ cm^{-2}), their energetic position (0.17 ev above the valence band), the concentration of the volume acceptors (10^9-10^{10} cm^{-3}) and the thickness of the enrichment barrier (0.06 mm at 200°K) were determined. In order to explain the course of conductivity at lower temperatures, at least another level is necessary; and below 50°K, in the case of polished surfaces, surface defect band conduction is necessary in addition. The determination of the surface state densities from the upper temperature region and their variation with increasing oxidation permits a quantitative observation of the oxidation process. With higher electric fields, pronounced deviations from the ohmic character occur, which are discussed. The measurement of the minority carrier life between room temperature and 90°K results in a temperature course differing from that known for the present due to the large junction thickness. It can be extensively interpreted by the assumption of a quasi-volume recombination in the surface layer. (auth)

25031 (SC-T-64-617) ON THE RADON ADSORPTION WITH ACTIVATED CHARCOAL IN THE OPEN SYSTEM OF THE FREE GAS FLOW. O. Guebeli and M. Stoeri. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.), from Helv. Chim. Acta, 38: 180-4(1955). 8p.

The adsorption of radon on activated charcoal was investigated by a dynamic method of free flow of gas through the system, utilizing distribution curves. Also the desorption of radium emanation in a nitrogen flux was examined for a maple wood charcoal of medium activity, using the quantitative approach. (P.C.H.)

25032 (SC-T-64-618) CHROMATOGRAPHIC PROCEDURES IN ORGANIC CHEMISTRY. Gerhard Hesse. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.), from Z. Anal. Chem., 181: 274-83(1961). 13p.

Separation through phase equilibriums by using an auxiliary phase, is discussed. The apparatus and the execution of a sorption analysis are determined by the prevalent basic phenomenon. Therefore, the solid phase and the liquid phase must be sought out and balanced with each other. Complex-forming additives or auxiliary substances can improve the specificness considerably. The most suitable construction of the apparatus for qualitative or quantitative analysis, as well as chemical equations, are briefly discussed. The possibilities of a racemate separation and of a fractionation of macromolecular substances, as well as ferment columns and reducing columns, are also presented. (P.C.H.)

25033 (SC-T-64-901) CHEMISORPTION AS THE INITIAL PROCESS IN THE REACTION OF GASES WITH SOLIDS. H. J. Engell. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.), from Z. Elektrochem., 66: 617-27(1962). 24p.

Reactions between gases and solids have the following sequence: collision process, adsorption, chemisorption, and reaction. Adsorption and chemisorption differ qualitatively and quantitatively with regard to the interaction between adsorbent and adsorbate. Several methods for determining the type and extent of the interaction are discussed. To determine the interaction at the chemisorption of gases on metals thin evaporated metal layers and measurements with the field emission microscope are especially suitable. The chemisorption of gases on semiconductors causes changes which penetrate from the surface into the interior of the solid due to the comparatively low charge-carrier concentrations in the semiconductors. The methods applicable in this case, the time laws of the rate of chemisorption, and the results of the investigations of several simple systems are discussed. As a consequence of chemisorption, transport processes occur in the surface regions of crystals of semiconducting compounds. (auth)

25034 (SC-T-64-902) A STUDY OF REMOTE INTERACTIONS WITHIN MACROMOLECULAR CHAINS. M. Leng and H. Benoît. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.), from J. Chim. Phys., 59: 929-32(1962). 8p.

The study of copolymers by means of diffusion of light contributed a direct experimental proof of the volume effect. It also showed that there is a good qualitative accord between experimental results and the theoretical investigation. (auth)

25035 (UCRL-Trans-1055(L)) POINT BY POINT STUDY OF THE SURFACE OF A CRYSTAL BY BERG-BARRETT TYPE METHODS. C. Bousquet, M. Lambert, A. M. Quittet, and A. Quinier. Translated for Univ. of California Lawrence Radiation Lab., Livermore, from Acta Cryst. 16: 989-93(1963). 15p.

The Berg-Barrett method was applied to rather imperfect crystals (various types of $BaTiO_3$). The contrast of the image depended on local variations, not of reflecting power, but of orientation and spacing of reflecting planes, and on the divergence of the incident beam. Different Berg-Barrett images combined with the measure of the direction of the reflected rays gave a detailed and accurate map of the crystal textures. (auth)

25036 THE JOINT RESEARCH AND DEVELOPMENT PROGRAM QUARTERLY DIGEST, VOL. 3, NO. 4, OCTOBER 1—DECEMBER 31, 1963. (United States-Euratom Joint Research and Development Program). 94p. $5.00 per yr. (Euratom)

A cumulative list of the EURATOM-United States contracts entered into force before December 31, 1963, is presented under the following headings: nuclear fuels, reactor materials, nuclear engineering, reactor physics, and miscellaneous. The scope of programs contracted for during the report period is outlined. Technical progress is reviewed. (N.W.R.)

CORPORATE AUTHOR INDEX

This index contains entries for this period for all report literature and, in addition, for certain published literature items for which it is felt that a corporate approach is especially desirable, e.g., symposia, conference proceedings, and meetings.

Each entry under a corporate author is a shortened version of the title of the publication, followed by the *NSA* volume and abstract number. Report numbers are given in parentheses.

The phrase "Progress report" is abbreviated as "Prog. rpt.," permitting a more rapid and complete alphabetical arrangement of the titles without changing the location of the progress report titles in relation to the other titles.

A

AERONUTRONIC. DIV. OF FORD MOTOR CO., NEWPORT BEACH, CALIF.

High-temperature tensile properties of ZTA grade graphite, 18: 24145 (WADD-TR-61-72(Vol.XIV))

AKADEMIYA NAUK BELORUSSKOĬ S.S.R. ENERGETICHESKIĬ INSTITUT, MINSK.

Structural changes and physical properties of reactor IRT-2000, 18: 24960 (NP-13911)

AKADEMIYA NAUK S.S.S.R.

Calculation of weak self-oscillatory conditions in reactors, 18: 24850 (NP-13963)
Peculiarities of partial waves J = I and asymptotics of amplitude of elastic scattering, 18: 24398 (NP-13872)
Research in nuclear and solid-state physics with research reactor IRT, 18: 24959 (NP-13910)
Thermalizing properties of water and certain organic compounds, 18: 24566 (NP-13912)
Yield of Na-24 from Al in H_2O during irradiation of Al, 18: 24592 (NP-13913)

AKADEMIYA NAUK UKR. S.S.R.

Injection accelerator of electrons with constant phase velocity, 18: 24244 (NP-13908)
Linear electron accelerator up to 90 Mev, 18: 24245 (NP-13914)
2-Bev linear electron accelerator, 18: 24248 (NP-13960)

ALABAMA. UNIV., HUNTSVILLE. RESEARCH INST.

Elastic scattering of slow electrons from alkali atoms, 18: 24298 (N64-13373)

ALLIS-CHALMERS MFG. CO., MILWAUKEE.

Prog. rpt. on vapor volume fraction and slip velocity, 1–3/64, 18: 23760 (ACNP-64022)

ALLIS-CHALMERS MFG. CO. ATOMIC ENERGY DIV., BETHESDA, MD.

Fuel loading for Elk River second core, 18: 24875 (ACNP-64536)
Prog. rpt. on La Crosse BWR, 3/64, 18: 24874 (ACNP-64529)
Zero power experiments for SM-1 Core III, 18: 24873 (ACNP-64517(Rev. 1))

AMES LAB., AMES, IOWA.

Consequent procedures in convention computers, 18: 24992 (IS-904)
Decomposition pressure of Ho carbides, 18: 23440 (CONF-405-38)
Table of $\sin^4\theta$ vs. θ and 2θ, 18: 24990 (IS-842)
Treatment of Cs ore, 18: 24991 (IS-884)

ANDREWS UNIV., BERRIEN SPRINGS, MICH.

Thermal expansion of isotopically enriched Li, 18: 23450 (TID-20252)

ARDE-PORTLAND, INC., PARAMUS, N. J.

Final rpt. on nuclear rocket engine nozzle, 3/64, 18: 24940 (NASA-CR-54000)

ARGONNE NATIONAL LAB., ILL.

Acoustically resonant Stirling engine, 18: 24364 (ANL-6802(p.166-9))
Advanced systems research and development, 18: 24953 (ANL-6880 (p.68-71))
Analysis of thermionic converters, 18: 24360 (ANL-6802(p.126-43))
ARGUS—program for calculating transient temperatures, 18: 23763 (ANL-6654)
Biosynthesis of methionine in *Saccharomyces cerevisiae*, 18: 23193 (ANL-6823(p.128-40))
Boiling water reactors, 18: 24951 (ANL-6880(p.1-5))
Charged-particle propulsion, 18: 24358 (ANL-6802(p.89-99))
Conference on direct energy conversion, Argonne, 11/63, 18: 24352 (ANL-6802)
Contact resistance of Fe-plated Pb telluride contact, 18: 24357 (ANL-6802(p.78-86))
Cylindrical lattice collision probability codes, 18: 24844 (ANL-6836)
Dose to gonads from injected Sr-90 and Y-90, 18: 23185 (ANL-6823 (p.76-80))
Effect of x radiation on oxidative phosphorylation in liver mitochondria, 18: 23233 (ANL-6823(p.157-60))
Effect on catalase of compounds related to aminotriazole, 18: 23178 (ANL-6823(p.91-8))
Effects of Pu injected subcutaneously in rat, 18: 23232 (ANL-6823 (p.81-5))
ELMOE—program treating elastic scattering in reactors, 18: 24811 (ANL-6805)
Evaluating power sources, 18: 24363 (ANL-6802(p.163-5))
Extended surface thermionic converters, 18: 24361 (ANL-6802(p.144-51))
Field emission from crystals of graphite, 18: 24121 (ANL-6804)
Foil activation programs, 18: 23871 (ANL-6822)
Fractionated irradiation of mice, 18: 23230 (ANL-6823(p.15-19))
General reactor technology, 18: 24813 (ANL-6880(p.49-67))
Heavy metal compounds as fixatives for electron microscopy, 18: 23162 (ANL-6823(p.174-7))
Hydride and bimetallic regenerative EMF cells, 18: 24355 (ANL-6802(p.53-63))
Intranuclear stratification in amoeba, 18: 23197 (ANL-6823(p.169-73))
Investigation of dense plasmas by laser radiation, 18: 24745 (ANL-6802(p.120-5))
Isolation cell components from *Amoeba proteus*, 18: 23191 (ANL-6823 (p.118-23))
Isotope separation factors occurring in chromatography of dual-labeled compounds, 18: 23194 (ANL-6823(p.141-51))
Liquid-metal-cooled reactors, 18: 24952 (ANL-6880(p.6-48))
MHD power generation, 18: 24359 (ANL-6802(p.101-9))
Nuclear Cross Sections Advisory Group Meeting, Savannah River, 1/64, 18: 24625 (WASH-1046)
Nuclear safety, 18: 23817 (ANL-6880(p.72-8))
Parameters of radiation dosage that influence osteogenic sarcomas, 18: 23231 (ANL-6823(p.20-43))
Photovoltaic energy conversion and fuel cell, 18: 24356 (ANL-

6802(p.64-5))

Plasma diagnostics using EM waves, 18: 24744 (ANL-6802(p.113-19))

Plastid development and chlorophyll production in Chlorella mutant C-10, 18: 23196 (ANL-6823(p.161-4))

Plutonium removal. IX., 18: 23190 (ANL-6823(p.111-13))

Plutonium removal. VII., 18: 23350 (ANL-6823(p.105-8))

Plutonium removal. V., 18: 23351 (ANL-6823(p.114-15))

Plutonium removal. VIII., 18: 23189 (ANL-6823(p.109-10))

Producing supersonic high electron density plasma, 18: 24743 (ANL-6802(p.29-36))

Prog. rpt. on biological medical research, semiannual, 1–6/63, 18: 23161 (ANL-6823)

Prog. rpt. on reactor development, 3/64, 18: 24812 (ANL-6880)

Prog. rpt. on toxicity and metabolism of radionuclides, 6/63, 18: 23184 (ANL-6823(p.44-75))

Program to simulate two-component chromatogram, 18: 23195 (ANL-6823 (p.152-6))

Properties of gases at high temperatures, 18: 24742 (ANL-6802(p.15-18))

Radiation effects on chick embryos, 18: 23229 (ANL-6823(p.5-14))

Reduction of erythrocyte catalase level. II., 18: 23186 (ANL-6823(p.86-90))

Segregation of structural elements during cell division, 18: 23163 (ANL-6823(p.178-88))

Solar energy conversion, 17: 24353 (ANL-6802(p.24-5))

Soluble proteins from cell nuclei, 18: 23192 (ANL-6823(p.124-7))

Specific heat of Tm metal, 18: 23442 (CONF-405-41)

Spectral evidence on rare-earth covalent binding, 18: 23438 (CONF-405-35)

Studies on ossifying cartilage, 18: 23188 (ANL-6823(p.102-4))

Thermionic energy conversion for d-c output, 18: 24362 (ANL-6802 (p.152-60))

Trimmer of specimen blocks for ultramicrotomy, 18: 23164 (ANL-6823 (p.189-90))

Triphosphopyridine nucleotide reduction by spinach chloroplasts, 18: 23198 (ANL-6823(p.191-8))

ARMY ENGINEER RESEARCH AND DEVELOPMENT LABS., FORT BELVOIR, VA.

Conference on detection of underground objects, Ft. Belvoir, 3/62, 18: 23781 (NP-13943)

Detection of underground objects by backscattered radiation, 18: 23782 (NP-13943(p.117-27))

Hydrodynamics of underground nuclear explosions, 18: 23783 (NP-13934 (p.209-14))

ARMY NUCLEAR DEFENSE LAB., EDGEWOOD ARSENAL, MD.

Neutron-flux and γ-dose measurements at AFRRI reactor, 18: 24957 (NDL-TR-59)

ASTROPOWER, INC., NEWPORT BEACH, CALIF.

Particle disintegration study for re-entering NAP systems, 18: 24933 (AFSWC-TDR-63-51)

ATOMIC BOMB CASUALTY COMMISSION, HIROSHIMA.

Deformities possibly due to thalidomide, 18: 25010 (TID-19257)

ATOMIC ENERGY OF CANADA LTD. POWER PROJECTS, TORONTO.

DEEMS–FORTRAN program for first-degree coupled differential equations, 18: 24061 (TDSI-49)

ATOMIC POWER DEVELOPMENT ASSOCIATES, INC., DETROIT.

Prog. rpt. on Na technology loop, 4/64, 18: 23411 (TID-20614)

ATOMICS INTERNATIONAL. DIV. OF NORTH AMERICAN AVIATION, INC., CANOGA PARK, CALIF.

Advanced development program, 18: 24996 (NAA-SR-8888(Sect.VI))

Advanced organic moderated reactor, 18: 24893 (NAA-SR-8888(Sect.III))

Advanced sodium cooled reactors, 18: 24891 (NAA-SR-8888(Sect.I))

ESADA fuel fabrication, 18: 23404 (AI-8700(Vol.V))

ESADA fuel fabrication, 18: 24095 (AI-8700(Vol.I))

ESADA fuel fabrication, 18: 24096 (AI-8700(Vol.II))

ESADA fuel fabrication, 18: 24097 (AI-8700(Vol.III))

ESADA fuel fabrication, 18: 24098 (AI-8700(Vol.IV))

Hallam nuclear power facility, 18: 24892 (NAA-SR-8888(Sect.II))

Initial operation of Hallam power facility, 18: 24878 (CONF-504-3)

Prog. rpt. on unclassified programs, annual, 1963, 18: 24995 (NAA-SR-8888)

Reactor safety, 18: 24816 (NAA-SR-8888(Sect.IV))

Separations chemistry, 18: 23701 (NAA-SR-8888(Sect.V))

Sodium–water reaction in SRE pipe gallery, 18: 24894 (NAA-SR-Memo-7743)

AVCO CORP. AVCO-EVERETT RESEARCH LAB., EVERETT, MASS.

Use of guard ring shields on negatively biased Langmuir ion collection current probes, 18: 24756 (NP-13946)

B

BABCOCK AND WILCOX CO., LYNCHBURG, VA.

Advanced test reactor fuel plate pressure deflection tests, 18: 24963 (TID-20621)

Reactor physics startup test of Indian Point reactor, 18: 24877 (BAW-189)

BABCOCK AND WILCOX CO. RESEARCH CENTER, ALLIANCE, OHIO.

Prog. rpt. on Na-heated steam generator, 3/64, 18: 23770 (TID-20604)

BALLISTIC RESEARCH LABS., ABERDEEN PROVING GROUND, MD.

Neutron reflection and flux versus depth for Al, 18: 24564 (BRL-1238)

BATTELLE MEMORIAL INST., COLUMBUS, OHIO.

Corrosion of Nb-base alloys in steam, 18: 24080 (BMI-X-286)

Evaluating power sources, 18: 24363 (ANL-6802(p.163-5))

Prog. rpt. on civilian applications, 2/64, 18: 24988 (BMI-1665(Del.))

Refractory ceramics of interest in aerospace structural applications, 18: 24141 (RTD-TDR-63-4102)

BATTELLE MEMORIAL INST. DEFENSE METALS INFORMATION CENTER, COLUMBUS, OHIO.

Application of high pressure in metal-deformation processing, 18: 24099 (DMIC-199)

BOEING CO., SEATTLE.

Prediction of pressure vessel minimum fatigue life, 18: 24130 (D2-22437)

BOLOGNA. UNIVERSITA.

Prog. rpt. on diffusion and precipitation of H in Zr, 10–11/63, 18: 24131 (EURAEC-921)

BROOKHAVEN NATIONAL LAB., UPTON, N. Y.

Biology of aging, 18: 23165 (BNL-854)

Charged sigma hyperon leptonic decays, 18: 24402 (TID-19033)

Crystal structure of ferroelectric Li hydrazinium sulfate, 18: 24989 (BNL-7034)

Effect of twinning on yield stress of polycrystalline Fe, 18: 24129 (CONF-524-5)

High-Temperature Liquid-Metal Technology Review, Vol. 2, No. 1, 18: 24064 (BNL-855)

STEAM—program to analyze spark chamber data, 18: 23872 (BNL-833)

Trace metals: essential or detrimental to life, 18: 23199 (BNL-828)

BROWN, BOVERI AND CO. LTD., BADEN, SWITZERLAND.

Primary circulators for A.V.R. Brown Boveri-Krupp reactor, 18: 24912 (TID-7690(p.1-15))

Primary circulators for O.E.C.D. high-temperature reactor project, 18: 24916 (TID-7690(p.189-206))

BRUSSELS. UNIVERSITE.

Fuel cycles in D_2O-moderated natural-U-fueled reactor, 18: 24905 (NP-13905)

Vaporization of alloys at high temperatures, 18: 23455 (WADD-TR-60-78 (Pt.XXII))

BUREAU OF MINES, BERKELEY, CALIF.

Thermodynamic data for NbC, 18: 23435 (BM-RI-6446)

BUREAU OF MINES, MORGANTOWN, W. VA.

High-temperature helium compressor, 18: 23745 (TID-7690(p.236-44))

BURNS AND ROE, INC., NEW YORK.

Dual-purpose power reactor for Florida Keys, 18: 24906 (NYO-10719)

C

CALIFORNIA INST. OF TECH., PASADENA.

Doppler effect in a medium, 18: 24741 (AFOSR-5367)

Examination of development-type thermionic power converters, 18: 24368 (JPL-TR-32-548)

Internal symmetries, 18: 24379 (CONF-510-1)

Superconducting metastable compounds, 18: 24142 (TID-20617)

CALIFORNIA. UNIV., BERKELEY.

Changes in physical properties of rocks in the vicinity of underground nuclear explosions, 18: 23786 (UCRL-13105)

Crystal structure of Mg sulfate hexahydrate, 18: 25020 (UCRL-10832)

Heats of formation of Eu^{+3}(aq), Eu^{+2}(aq), and $EuO_{1.02}$, 18: 23453 (UCRL-11126)
Liquid-liquid settling, 18: 23708 (UCRL-11182)

CALIFORNIA. UNIV., BERKELEY. INST. OF ENGINEERING RESEARCH.
Changes in physical properties of rocks in the vicinity of underground nuclear explosions, 18: 23786 (UCRL-13105)

CALIFORNIA. UNIV., BERKELEY. LAWRENCE RADIATION LAB.
Crystal structure of Mg sulfate hexahydrate, 18: 25020 (UCRL-10832)
Effective charges of products of heavy-ion-induced spallation, 18: 24624 (UCRL-10806)
Excess-kinetic-energy ions in organic mass spectra. I., 18: 25019 (UCRL-10823)
Facilities and activity on 184-in. cyclotron, 18: 24249 (UCRL-11316)
FORTRAN II—program to compute neutron-detection efficiency of scintillator, 18: 23891 (UCRL-11339)
Heats of formation of Eu^{+3}(aq), Eu^{+2}(aq), and $EuO_{1.02}$, 18: 23453 (UCRL-11126)
Influence of quenching conditions on vacancy loops in Al, 18: 24144 (UCRL-11188)
Liquid-liquid settling, 18: 23708 (UCRL-11182)
Longitudinal dispersion in process equipment, 18: 23755 (UCRL-11157)
Mechanism of liquid-liquid settling, 18: 23452 (UCRL-10625)
Mirroring protons in South Atlantic anomaly, 18: 24515 (UCRL-11409)
Prog. rpt. on controlled thermonuclear research, semiannual, 7–12/63, 18: 24763 (UCRL-11172)
Remote pipetters for hot-cell enclosures, 18: 23842 (UCRL-9661)
Scattering of π mesons from polarized proton target, 18: 24404 (UCRL-11149)
Scattering of 65-Mev He ions from O-16, 18: 24623 (UCRL-10727)

CALIFORNIA. UNIV., LA JOLLA.
Superconducting metastable compounds, 18: 24142 (TID-20617)

CALIFORNIA. UNIV., LIVERMORE. LAWRENCE RADIATION LAB.
Computer analysis of fluid flow involving real gases, 18: 23772 (UCRL-7530)
Computer code for thermodynamic analysis for W and Re vapor plating, 18: 23451 (UCRL-7667)
Contained nuclear explosions for evaluation of mining applications, 18: 23751 (UCRL-7350)
Crater nomenclature, 18: 25018 (UCRL-7750)
Cratering experience with chemical and nuclear explosives, 18: 23752 (UCRL-7793)
Equipotential zoning of two-dimensional meshes, 18: 25014 (UCRL-7312)
Ferromagnetism in dilute solutions of Fe in Au, 18: 24143 (UCRL-7390)
Finite-resistivity instability of tubular sheet pinch, 18: 24762 (UCRL-7077)
High-temperature optical extensometer, 18: 25017 (UCRL-7405)
Isomers of chloroiodotrifluoroethane, 18: 25016 (UCRL-7373)
Nucleon-nucleon elastic scattering matrix. I., 18: 24403 (UCRL-7563-T)
O-ring seals at high pressure, 18: 25015 (UCRL-7359)
Prog. rpt. on hazards control, 10–12/63, 18: 23828 (UCRL-7637)
Safety analysis for Super Kukla Prompt Burst Reactor, 18: 24964 (UCRL-7695)
Titration of boric acid in aqueous solution, 18: 23412 (UCRL-7756)
Two-dimensional Lagrangian hydrodynamic difference equations, 18: 23771 (UCRL-6776)

CALIFORNIA. UNIV., LOS ANGELES.
Effects of cratering test on lizards, 18: 23181 (UCLA-12-522)

CARNEGIE INST. OF TECH., PITTSBURGH.
Nuclear deformations in pairing-plus-quadrupole model I, 18: 24614 (NP-13941)

CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC., PARR, S. C.
Prog. rpt. on CVTR operation, 10/63–3/64, 18: 24879 (CVNA-204)

CENTRE D'ETUDE DE L'ENERGIE NUCLEAIRE, MOL, BELGIUM.
Excretion of β-aminoisobutyric acid and creatine after irradiation, 18: 23234 (EUR-591.d)

CHICAGO RAWHIDE MFG. CO.
Welded-metal-bellows shutdown seals, 18: 24823 (TID-7690(p.176-88))

CHICAGO. UNIV. AIR FORCE RADIATION LAB.
Chemical radioprotection against absorber-moderator protons, 18: 23357 (NP-13918(p.107-15))
Dose-mortality relationships for radioprotective agents, 18: 23355 (NP-13918(p.75-98))
Effect of 2-mercaptoethylamine or *para*-aminopropionphenone to diets of irradiated mice, 18: 23358 (NP-13918(p.116-28))
Effects of 2-imino-thiazolidine-4-carboxylic acid on radioprotective activity of agents, 18: 24453 (NP-13918(p.42-57))
Influence of chemical compounds on radiation lethality in mice, 18: 23354 (NP-13918(p.58-74))
Influence of steroids on radiation-sensitive detoxification systems, 18: 23352 (NP-13918(p.28-41))
Influence of x irradiation on thiophosphate-oxidizing enzyme system in livers, 18: 23241 (NP-13918(p.13-27))
Prog. rpt. on radiobiology, 4/15/64, 18: 23166 (NP-13918)
Radiation effects on biochemistry of tissues. I., 18: 23202 (NP-13918 (p.1-12))
Sodium nitrite in radioprotection in mice, 18: 23356 (NP-13918(p.99-106))

CHICAGO WESLEY MEMORIAL HOSPITAL.
Determination of taurine in urine, 18: 25007 (TID-18929)
Excretion of taurine-S^{35} and sulfate-S^{35}, 18: 25006 (TID-18927)

CINCINNATI. UNIV.
Specific heat and emissivity of Ta, 18: 24122 (ASD-TDR-63-371)

COLUMBIA UNIV., IRVINGTON-ON-HUDSON, N. Y. NEVIS LABS.
Parity conservation in Λ^0 production in C nuclei, 18: 24394 (NEVIS-122)

COLUMBIA UNIV., PALISADES, N. Y. LAMONT GEOLOGICAL OBSERVATORY.
Dye diffusion experiment off Long Island, 18: 25013 (TID-20612)

COMBUSTION ENGINEERING, INC., WINDSOR, CONN.
Prog. rpt. on stress-corrosion cracking of stainless steels, 1–3/64, 18: 24125 (CEND-3256-209)
Prog. rpt. on UO_2 fuel systems, 4/64, 18: 24854 (CEND-2863-211)

COMPAGNIE FRANÇAISE THOMSON-HOUSTON, PARIS.
Prog. rpt. on nuclear vapotron, 5–9/62, 18: 24862 (EURAEC-541)
Prog. rpt. on nuclear vapotron, 10–12/62, 18: 24863 (EURAEC-694)
Prog. rpt. on nuclear vapotron, 1–3/63, 18: 24864 (EURAEC-770)

COMPAGNIE PECHINEY, PARIS.
Prog. rpt. on Zr–V alloys, 10–12/62, 18: 24150 (EURAEC-538)

CONSOLIDATED EDISON CO. OF NEW YORK, INC.
Reactor physics startup test of Indian Point reactor, 18: 24877 (BAW-189)

CONSUMERS PUBLIC POWER DISTRICT, HALLAM, NEBR.
Initial operation of Hallam power facility, 18: 24878 (CONF-504-3)

CORNELL UNIV., NEW YORK. MEDICAL COLL.
Amino acids as punctuation in genetic code of DNA, 18: 25011 (TID-20348)

D

DEFENSE ATOMIC SUPPORT AGENCY. FIELD COMMAND, ALBUQUERQUE, N. MEX.
Summary of Sherwood activities, 18: 24755 (NP-13895)

DENVER. UNIV.
Vapor pressures of Sm and Gd, 18: 23439 (CONF-405-36)

DEUTSCHES ATOMFORUM E. V., DÜSSELDORF.
Angular distribution inelastic diffusion of neutrons in C, 18: 24603 (NP-13930(p.51-3))
Back-scattering proton spectrometer for measuring fast neutron spectra, 18: 23883 (NP-13930(p.147-57))
Beam tube experiments with a divided core, 18: 24849 (NP-13930(p.130))
Cold neutrons by total reflection, 18: 24569 (NP-13930(p.119-20))
Comparison of coherent scattering lengths on a neutron interferometer, 18: 23878 (NP-13930(p.76-7))
Conference on neutron physics, Karlsruhe, 10/63, 18: 24567 (NP-13930
Construction and manner of operation of neutron refractometer, 18: 23838 (NP-13930(p.122-4))
Cross section measurements on Pd for epithermal neutron energies, 18: 24609 (NP-13930(p.112-13))
Cross sections of nuclear reactions caused by neutrons, 18: 24601 (NP-13930(p.41-2))
Energy dependence of neutron cross sections, 18: 24602 (NP-13930

(p.43-9))
Inelastic scattering cross sections on Na-23 to 4 Mev, 18: 24597 (NP-13930(p.15))
Inelastic scattering of neutrons on V hydride, 18: 24605 (NP-13930 (p.59-71))
Interaction cross sections for slow neutrons, 18: 24606 (NP-13930 (p.73-4))
Karlsruhe Van de Graaff project for fast neutrons, 18: 24246 (NP-13930 (p.137-8))
Measurement of (n,γ) cross sections and resonance integrals, 18: 24608 (NP-13930(p.110-11))
Measurement of the isomeric splitting ratio of In resonances, 18: 24610 (NP-13930(p.114-15))
Neutron flash tube—a strong, pulsed neutron source, 18: 24570 (NP-13930(p.141-3))
Neutron generator with duoplasmatron ion source, 18: 24247 (NP-13930 (p.140))
Neutron-induced reactions in Si semiconductor counters, 18: 24599 (NP-13930(p.26-38))
Neutron interaction cross sections on Si, 18: 24600 (NP-13930(p.39-40))
New work on level densities, 18: 24596 (NP-13930(p.14))
Nuclear physics experiments on the FRM, 18: 24961 (NP-13930(p.80-103))
Nuclear physics investigations by the (n,γ) reaction, 18: 24607 (NP-13930(p.104-8))
Nuclear reactions and optical nuclear model, 18: 24594 (NP-13930 (p.1-5))
Nuclear reactions induced by 14.7-Mev neutrons, 18: 24613 (NP-13930(p.139))
Passage of polarized neutrons through magnetized Fe, 18: 24568 (NP-13930(p.78-9))
Precision crystal spectrometer for slow neutrons, 18: 23881 (NP-13930 (p.128-9))
Production investigations for 14-Mev neutrons from $H^3(d,n)He^4$, 18: 24604 (NP-13930(p.54-5))
Reaction (d,n) on Be-9, B-10, B-11, Si-28, and P-31, 18: 24611 (NP-13930(p.132-3))
Reaction $Ti^{48}(p,n)V^{48}$, 18: 24612 (NP-13930(p.134))
Rotating-crystal spectrometer for scattering experiments with slow neutrons, 18: 23879 (NP-13930(p.126))
Scattering of slow neutrons on rotating molecules, 18: 24299 (NP-13930(p.56-7))
Scattering of subthermal neutrons on lattice defects, 18: 24194 (NP-13930(p.116-17))
Spectrometry of fast neutrons with semiconductors, 18: 23884 (NP-13930 (p.159-77))
Statistics of nuclear level intervals and widths, 18: 24598 (NP-13930 (p.17-25))
Suppression of reflections in rotating-crystal spectrometer, 18: 23880 (NP-13930(p.127))
Threshold detectors for fast neutron fluxes, 18: 23885 (NP-13930 (p.178-80))
Time-of-flight spectrometer for fast neutrons, 18: 23882 (NP-13930 (p.144-6))
Transmission coefficients and absorption cross sections according to optical model, 18: 24595 (NP-13930(p.6-13))

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Gas chromatograph for determining O_2, N_2, NO, N_2O, SO_2, and H_2S in steam, 18: 23407 (DP-880)
Removal of Cs from evaporator condensate, 18: 23700 (DP-876)

DUKE UNIV., DURHAM, N. C.
Precision accelerator voltage measurements, 18: 24242 (CONF-22-33)

DUQUESNE LIGHT CO., SHIPPINGPORT, PENNA.
Reactor container integrity test, 18: 24880 (DLCS-3570501)
Reactor cooldown and temperature control system, 18: 24881 (DLCS-4140301)

E

EBASCO SERVICES, INC., NEW YORK.
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Prog. rpt. on heat transfer and stability in BWR, 10/63–1/64, 18: 24883 (EURAEC-963)

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Crystal structure of ferroelectric Li hydrazinium sulfate, 18: 24989 (BNL-7034)

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Calibration loop for magnetic flowmeter, 18: 23765 (EUR-1631.d)
Excretion of β-aminoisobutyric acid and creatine after irradiation, 18: 23234 (EUR-591.d)
Fast neutron multiplication factor, 18: 24846 (EUR-1618.e)
First CAPEL experiment, 18: 24747 (CEA-R-2417)
High-vacuum Li discharge, 18: 24750 (EUR-1627.f)
Ionization and recombination in H-, He-, and Li-plasma, 18: 24751 (EUR-CEA-FC-200)
Karlsruhe Van de Graaff project for fast neutrons, 18: 24246 (NP-13930 (p.137-8))
Physical properties of OM_2 for heat transfer purposes, 18: 23569 (EUR-1619.e)
Structural properties of stainless steels, 18: 24151 (EURAEC-986)

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Calibration loop for magnetic flowmeter, 18: 23765 (EUR-1631.d)
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Physical properties of OM_2 for heat transfer purposes, 18: 23569 (EUR-1619.e)

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Comparison of proton and deuteron acceleration, 18: 24241 (CERN-64-22)
Synchronization between 300-Bev synchrotron and its booster injector, 18: 24240 (CERN-64-20)

F

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Shielding for ANP program, 18: 24934 (ANP-53)

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Prog. rpt. on explosive parameters for MHD energy conversion, final, 6/24/60–7/24/63, 18: 24365 (ASD-TDR-63-37)

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Conditioned aversion to saccharin during post exposure period, 18: 23240 (FSU-2690-15(Paper 7))
Conditioned aversion to saccharin using x rays as unconditioned stimulus, 18: 23239 (FSU-2690-15(Paper 5))
Effects of atropine sulfate and physostigmine on aversion to saccharin with x rays as stimulus, 18: 23236 (FSU-2690-15(Paper 2))
Radiations as noxious stimuli, 18: 23235 (FSU-2690-15)
Reaction $Ti^{46}(p,n)V^{46}$, 18: 24612 (NP-13930(p.134))

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Design of reactor complex and loading mechanism, 18: 24919 (ORNL-tr-82)
Economic aspects of enrichment of U by gaseous diffusion, 18: 24054 (ORNL-tr-134)
Production of UO_2 crystals, 18: 23458 (HW-tr-71)
Prog. rpt. on Pu recycling, 1963, 18: 24865 (EURAEC-992)
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Dislocations of alpha U, 18: 24201 (ANL-Trans-22)
First CAPEL experiment, 18: 24747 (CEA-R-2417)
High-vacuum Li discharge, 18: 24750 (EUR-1627.f)
Ionization and recombination in H-, He-, and Li-plasma, 18: 34751 (EUR-CEA-FC-200)
Pollution of milk by I-131, 18: 23819 (CEA-R-2409)
Precipitation of uranium oxide, 18: 23436 (CEA-R-2414)

FRANCE. COMMISSARIAT À L'ÉNERGIE ATOMIQUE. CENTRE D'ÉTUDES NUCLÉAIRES, SACLAY.
Oxidation of unirradiated and irradiated nuclear graphites, 18: 24202 (GA-tr-5174)
Period safety trip during reactor startup, 18: 24814 (CEA-R-2411)
Resistivity measurements using d-c induction method, 18: 23837 (CEA-R-2402)
Synthesis of phenobarbital C-14, 18: 23568 (CEA-R-2406)
Transformation of U–Nb alloys, 18: 24124 (CEA-2341)

FRANCE. COMMISSARIAT A L'ENERGIE ATOMIQUE. CENTRE DE PRODUCTION DE PLUTONIUM DE MARCOULE, CHUSCLAN.
Measuring U in biological media, 18: 23405 (CEA-R-2415)
Solvent purification in plants treating irradiated fuels, 18: 23698 (CEA-R-2404)

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Design of reactor complex and loading mechanism, 18: 24919 (ORNL-tr-82)

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Neutron interaction cross sections on Si, 18: 24600 (NP-13930(p.39-40))
New work on level densities, 18: 24596 (NP-13930(p.14))
Nuclear physics investigations by the (n,γ) reaction, 18: 24607 (NP-13930(p.104-8))
Nuclear reactions and optical nuclear model, 18: 24594 (NP-13930 (p.1-5))
Transmission coefficients and absorption cross sections according to optical model, 18: 24595 (NP-13930(p.6-13))

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Fire simulation in shipping container studies, 18: 23827 (NYO-2539-1)
Pressure distribution in gas-lubricated, tilting-pad, journal bearings, 18: 23747 (TID-7690(p.273-302))
Stability of flexible rotor subjected to rotary damping, 18: 23749 (TID-7690(p.313-30))

G

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Prog. rpt. on effect of neutron irradiation on materials, 10/63–1/64, 18: 24190 (GA-5037)

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Dynamics of P-140 reactor mockup, 18: 24936 (APEX-636)
Organic, structural and control materials, 18: 24937 (APEX-917)
Prog. rpt. on high-temperature materials, 4/15/64, 18: 24065 (GEMP-34A)
Prog. rpt. on maritime nuclear steam generator, 5/64, 18: 24939 (GEMP-285)

GENERAL ELECTRIC CO. AIRCRAFT NUCLEAR PROPULSION DEPT., CINCINNATI.
Navy seaplane power plant. IV., 18: 24935 (APEX-260)
Radiation damage of LiH, 18: 24188 (APEX-329)
Radiation levels within and behind BeO, 18: 24806 (XDC-61-1-149)

GENERAL ELECTRIC CO. AIRCRAFT NUCLEAR PROPULSION PROJECT, CINCINNATI.
Internal fuses for power reactors, 18: 24876 (APEX-142)

GENERAL ELECTRIC CO. ATOMIC POWER EQUIPMENT DEPT., SAN JOSE, CALIF.
Prog. rpt. on high-performance UO_2 programs, 1–3/64, 18: 24855 (GEAP-3771-12)
Prog. rpt. on high-power-density development, 10–12/63, 18: 24885 (GEAP-4488)
Prog. rpt. on nuclear superheat, 8–10/63, 18: 24884 (GEAP-4419)
Prog. rpt. on nuclear superheat, 11/63–1/64, 18: 24886 (GEAP-4565)

GENERAL ELECTRIC CO. ATOMIC PRODUCTS EQUIPMENT DEPT., SAN JOSE, CALIF.
Prog. rpt. on two-phase pressure losses, 8/12–11/11/63, 18: 23766 (GEAP-4431)

GENERAL ELECTRIC CO. FLIGHT PROPULSION LAB. DEPT., CINCINNATI.
Critical experiment P127, 18: 24845 (APEX-638)
Heat transfer of rod matrices, 18: 23764 (APEX-724)
Metallic wire fuels, 18: 24189 (APEX-730)

GENERAL ELECTRIC CO. HANFORD ATOMIC PRODUCTS OPERATION, RICHLAND, WASH.
Annunciator for a reactor automatic controller, 18: 24887 (HW-80921)
Behavior of Ni plate on Al alloys in aqueous systems, 18: 24083 (HW-81196)
Effects of neutron irradiation on Zy-2, 18: 24191 (HW-SA-3194)
Effects of temperature and irradiation on austenitic stainless steels, 18: 24192 (HW-SA-3221)
Fission-product shipping cask, 18: 23823 (HW-65268)
Grain size test for U fuel, 18: 24132 (HW-81752)
Irradiation effects on high-temperature reactor structural metals, 18: 24193 (HW-SA-3436)
Metabolism of SNAP radionuclides in swine, 18: 23200 (HW-SA-3350)
Monitor for As-76 concentrations in reactor cooling water, 18: 24821 (HW-75374)
Oxide tenacity on alloys exposed to coolants, 18: 24082 (HW-79811)
Precipitation scavenging efficiencies for ZnS particles, 18: 24212 (HW-SA-3167)
Prog. rpt. on programming, 1/64, 18: 24858 (HW-80560F)
Prog. rpt. on solidification of radioactive wastes, 9/62–3/64, 18: 24975 (HW-8182 9)
Radiological control experience with Pu fuels, 18: 23824 (HW-81363)
Sample changer for γ scintillation well detector, 18: 23873 (HW-80798)
Two-dimensional analog simulation for reactor, 18: 24847 (HW-79446)
Water–graphite relationships at constant moderation, 18: 24888 (HW-SA-3507)
Water quality monitoring system for NPR, 18: 24932 (HW-SA-3018)
Water treatment at Hanford, 18: 23443 (HW-77710)
Welding procedures and specifications, 18: 24102 (TID-20625(Vol.I))
Welding procedures and specifications, 18: 24103 (TID-20625(Vol.II))
Welding procedures and specifications, 18: 24104 (TID-20625(Vol.III))
Welding Pu-containing fuel elements, 18: 24100 (HW-SA-3146)

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Liquid metal cells, 18: 24354 (ANL-6802(p.49-52))

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Prog. rpt. on hydraulic ball control system, 1–3/64, 18: 24820 (GNEC-337)

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Cross sections of nuclear reactions caused by neutrons, 18: 24601 (NP-13930(p.41-2))

Energy dependence of neutron cross sections, 18: 24602 (NP-13930 (p.43-9))

Neutron-induced reactions in Si semiconductor counters, 18: 24599 (NP-13930(p.26-38))

Photoproduction of pions and Regge poles, 18: 24380 (DESY-64/3)

Reaction (d,n) on Be-9, B-10, B-11, Si-28, and P-31, 18: 24611 (NP-13930(p.132-3))

Time-of-flight spectrometer for fast neutrons, 18: 23882 (NP-13930 (p.144-6))

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Back-scattering proton spectrometer for measuring fast neutron spectra, 18: 23883 (NP-13930(p.147-57))

Spectrometry of fast neutrons with semiconductors, 18: 23884 (NP-13930 (p.159-77))

Threshold detectors for fast neutron fluxes, 18: 23885 (NP-13930 (p.178-80))

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Kinematical fitting program for analysis of bubble chamber events, 18: 23877 (NIRL/M/38)

H

HUDSON INST., INC., HARMON-ON-HUDSON, N. Y.

Aspects of environment resulting from nuclear wars. II., Annex III., 18: 23178 (HI-303-RR/A-III)

Aspects of environment resulting from nuclear wars. II., Annex IV., 18: 23822 (HI-303-RR/A-IV)

Aspects of environment resulting from nuclear war. II., 18: 23821 (HI-303-RR)

Environment resulting from nuclear wars. II., App. 1–2, 18: 23179 (HI-303-RR/A1-2)

HUGHES AIRCRAFT CO., MALIBU, CALIF.

Prog. rpt. on ion rocket engine development, 10/14/63–1/13/64, 18: 23740 (NP-13899)

I

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Laves phases of rare earths with transition elements, 18: 24126 (CONF-405-32)

Photovoltaic energy conversion and fuel cell, 18: 24356 (ANL-6802(p.64-5))

Prog. rpt. on reactor containment, 2–4/64, 18: 24824 (TID-20613)

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Absorption of π^- in light nuclei, 18: 24582 (AD-439331)

Charged-particle propulsion, 18: 24358 (ANL-6802(p.89-99))

Extended surface thermionic converters, 18: 24361 (ANL-6802(p.144-51))

Investigation of dense plasmas by laser radiation, 18: 24745 (ANL-6802(p.120-5))

Plasma diagnostics using EM waves, 18: 24744 (ANL-6802(p.113-19))

INDIA. ATOMIC ENERGY ESTABLISHMENT, TROMBAY.

Canada India reactor operating experience, 18: 24949 (AEET/ROD/7)

Commissioning of nuclear reactors, 18: 24810 (AEET/ROD/10)

Electrical conductivity and thermoelectric power of δ-U_4O_9. II., 18: 24120 (AEET/CD/21)

Electronic equipment at CIR, 18: 24948 (AEET/ROD/6)

Environmental radioactivity in India from nuclear weapon tests, 1962-63, 18: 23789 (AEET/AM/39)

Organization and administration of reactor operations, 18: 24950 (AEET/ROD/9)

Radioactivity in cooling water in swimming pool reactor, 18: 24947 (AEET/AM/38)

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Prog. rpt. on [elementary particles], 3/64, 18: 24399 (NP-13966)

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IAEA laboratory at Vienna and Seibersdorf, 18: 25004 (STI/DOC/10/25(p.9-69))

Marine biological project at Monaco, 18: 23167 (STI/DOC/10/25 (p.71-98))

Middle eastern regional radioisotope center for Arab countries, 18: 2316 (STI/DOC/10/25(p.99-111))

Prog. rpt. on IAEA laboratory activities, 1964, 18: 25003 (STI/DOC/10/25)

Strontium-90 content of marine organisms, 18: 23792 (WP/37)

IOWA. STATE UNIV., IOWA CITY.

Contrasts and conflicts of S matrix and field theory, 18: 24483 (SUI-63-21)

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Prog. rpt. on high-altitude balloon sampling, 4/24/64, 18: 23791 (NYO-10496(Add.))

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Ispra-2—description and safety, 18: 24962 (RT/ING(63)-25)

Monitor for exposure dose intensity, 18: 23889 (RT/EL(64)-1)

Rapid separation of Np-239 and Pa-233, 18: 23409 (RT/CHI(63)-31)

Thermocouple irradiation tests, 18: 23840 (RT/ING(64)-2)

ITALY. ISTITUTO SUPERIORE DI SANITÀ, ROME.

Analysis of excitation curves in photoproduction, 18: 24381 (ISS-64/4)

Calibration of encapsulated Ra sources, 18: 23387 (ISS-64/2)

Use of internal beam of synchrotron for study of reaction (e,e′p), 18: 24243 (ISS-63/42)

J

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Acausality and dispersion relations, 18: 24383 (JINR-E-1646)

Asymptotic relations between cross sections with EM interaction, 18: 24382 (JINR-E-1623)

Coupling between shell model excitations and cluster excitations in light nuclei, 18: 24588 (JINR-P-1595)

Diffraction p-p scattering, 18: 24392 (JINR-P-1632)

Electromagnetic properties of baryons in unitary symmetry model, 18: 24388 (JINR-P-1616)

Inelastic interactions of particles at high energies, 18: 24384 (JINR-P-1577)

Investigations of γ-quanta, produced in interactions of π^--mesons with nucleons and nuclei at ≈7 Bev, 18: 24391 (JINR-P-1629)

Isotropic discharge chamber for detecting tracks of relativistic charged particles, 18: 23874 (JINR-P-1619)

Polarization of protons in single crystals of LaMg double nitrate, 18: 23444 (JINR-P-1626)

Production of particles in nuclei, 18: 24587 (JINR-P-1584)

Properties of π^0 mesons produced in π^--N and π^--C interactions, 18: 24390 (JINR-P-1624)

Radiative resonance decays involving Λ hyperons, 18: 24387 (JINR-P-1615)

Spin correlation coefficients in elastic 315-Mev scattering, 18: 2438 (JINR-P-1617)

Verification of dispersion relations in small-angle- and high-energy region, 18: 24386 (JINR-P-1598)

Virtual excitations of compound particle, 18: 24385 (JINR-P-1593)

K

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Interaction cross sections for slow neutrons, 18: 24606 (NP-13930 (p.73-4))
Scattering of slow neutrons on rotating molecules, 18: 24299 (NP-13930(p.56-7))

KERNFORSCHUNGSZENTRUM, KARLSRUHE, GERMANY.
Determination of absolute thermal neutron flux by Au foils, 18: 23876 (KFK-180)
Karlsruhe Van de Graaff project for fast neutrons, 18: 24246 (NP-13930 (p.137-8))
Measurement of (n,y) cross sections and resonance integrals, 18: 24608 (NP-13930(p.110-11))
Measurement of the isomeric splitting ratio of In resonances, 18: 24610 (NP-13930(p.114-15))
Neutron flash tube—a strong, pulsed neutron source, 18: 24570 (NP-13930(p.141-3))
Neutron generator with duoplasmatron ion source, 18: 24247 (NP-13930 (p.140))
Precision crystal spectrometer for slow neutrons, 18: 23881 (NP-13930 (p.128-9))
Reaction Ti^{48}(p,n)V^{48}, 18: 24612 (NP-13930(p.134))
Rotating-crystal spectrometer for scattering experiments with slow neutrons, 18: 23879 (NP-13930(p.126))
Statistics of nuclear level intervals and widths, 18: 24598 (NP-13930 (p.17-25))

KERNREAKTOR BAU- UND BETRIEBS-GESELLSCHAFT M.B.H., KARLSRUHE, GERMANY.
Angular distribution inelastic diffusion of neutrons in C, 18: 24603 (NP-13930(p.51-3))
Back-scattering proton spectrometer for measuring fast neutron spectra, 18: 23883 (NP-13930(p.147-57))
Beam tube experiments with a divided core, 18: 24849 (NP-13930(p.130))
Cold neutrons by total reflection, 18: 24569 (NP-13930(p.119-20))
Comparison of coherent scattering lengths on a neutron interferometer, 18: 23878 (NP-13930(p.76-7))
Conference on neutron physics, Karlsruhe, 10/63, 19: 24567 (NP-13930)
Construction and manner of operation of neutron refractometer, 18: 23838 (NP-13930(p.122-4))
Cross section measurements on Pd for epithermal neutron energies, 18: 24609 (NP-13930(p.112-13))
Cross sections of nuclear reactions caused by neutrons, 18: 24601 (NP-13930(p.41-2))
Energy dependence of neutron cross sections, 18: 24602 (NP-13930 (p.43-9))
Inelastic scattering cross sections on Na-23 to 4 Mev, 18: 24597 (NP-13930(p.15))
Inelastic scattering of neutrons on V hydride, 18: 24605 (NP-13930 (p.59-71))
Interaction cross sections for slow neutrons, 18: 24606 (NP-13930 (p.73-4))
Karlsruhe Van de Graaff project for fast neutrons, 18: 24246 (NP-13930 (p.137-8))
Measurement of (n,y) cross sections and resonance integrals, 18: 24608 (NP-13930(p.110-11))
Measurement of the isomeric splitting ratio of In resonances, 18: 24610 (NP-13930(p.114-15))
Neutron flash tube—a strong, pulsed neutron source, 18: 24570 (NP-13930(p.141-3))
Neutron generator with duoplasmatron ion source, 18: 24247 (NP-13930 (p.140))
Neutron-induced reactions in Si semiconductor counters, 18: 24599 (NP-13930(p.26-38))
Neutron interaction cross sections on Si, 18: 24600 (NP-13930(p.39-40))
New work on level densities, 18: 24596 (NP-13930(p.14))
Nuclear physics experiments on the FRM, 18: 24961 (NP-13930(p.80-103))
Nuclear physics investigations by the (n,y) reaction, 18: 24607 (NP-13930(p.104-8))
Nuclear reactions and optical nuclear model, 18: 24594 (NP-13930 (p.1-5))
Nuclear reactions induced by 14.7-Mev neutrons, 18: 24613 (NP-13930(p.139))
Passage of polarized neutrons through magnetized Fe, 18: 24568 (NP-13930(p.78-9))
Precision crystal spectrometer for slow neutrons, 18: 23881 (NP-13930 (p.128-9))
Production investigations for 14-Mev neutrons from H^3(d,n)He^4, 18: 24604 (NP-13930(p.54-5))
Reaction (d,n) on Be-9, B-10, B-11, Si-28, and P-31, 18: 24611 (NP-13930(p.132-3))
Reaction Ti^{48}(p,n)V^{48}, 18: 24612 (NP-13930(p.134))
Rotating-crystal spectrometer for scattering experiments with slow neutrons, 18: 23879 (NP-13930(p.126))
Scattering of slow neutrons on rotating molecules, 18: 24299 (NP-13930(p.56-7))
Scattering of subthermal neutrons on lattice defects, 18: 24194 (NP-13930(p.116-17))
Spectrometry of fast neutrons with semiconductors, 18: 23884 (NP-13930 (p.159-77))
Statistics of nuclear level intervals and widths, 18: 24598 (NP-13930 (p.17-25))
Suppression of reflections in rotating-crystal spectrometer, 18: 23880 (NP-13930(p.127))
Threshold detectors for fast neutron fluxes, 18: 23885 (NP-13930 (p.178-80))
Time-of-flight spectrometer for fast neutrons, 18: 23882 (NP-13930 (p.144-6))
Transmission coefficients and absorption cross sections according to optical model, 18: 24595 (NP-13930(p.6-13))

KIEL. UNIVERSITÄT.
Cold neutrons by total reflection, 18: 24569 (NP-13930(p.119-20))
Cross section measurements on Pd for epithermal neutron energies, 18: 24609 (NP-13930(p.112-13))
Passage of polarized neutrons through magnetized Fe, 18: 24568 (NP-13930(p.78-9))

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FORDRAM—program to calculate group average microscopic resonance absorption and fission cross sections, 18: 24589 (KAPL-M-6131)
GRAPH—subroutine to draw curves with Philco-2000, 18: 24059 (KAPL-M-6144)
Mass analysis of small samples utilizing sputtering ion source, 18: 23406 (CONF-512-4)
Program for prediction of hydrodynamic flow oscillations, 18: 23767 (KAPL-M-6149)
Programs available on Philco-2000 computer. 1., 18: 24993 (KAPL-M-6139)
Theoretical experiment in subcooled nucleate boiling, 18: 23769 (TID-19075)
Zircaloy-2 hydrogen-uptake characteristics, 18: 24081 (CONF-509-1)

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Coupled-core reactors, 18: 24848 (LAMS-2967)

Fixation of atomic wastes in inert solid materials, 18: 24976 (LADC-6398)
High-temperature chemistry of refractory carbides, 18: 24133 (LADC-6391)
Los Alamos critical-mass data, 18: 24349 (LAMS-3067)
Neutron-proton depolarization parameter, 18: 24393 (LADC-6357)
Physiological properties of Pu and body burden in man, 18: 23825 (LADC-6104)
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Reaction (He^3,d) on $Ni^{58,60}$, 18: 24590 (LADC-6370)

LOUVAIN, BELGIUM. UNIVERSITÉ.
Fuel cycles in organic moderated reactors, 18: 24904 (NP-13904)

M

MARQUETTE UNIV., MILWAUKEE.
Nuclear reactions induced by 14.7-Mev neutrons, 18: 24613 (NP-13930(p.139))

MARTIN-MARIETTA CORP. AEROSPACE DIV., BALTIMORE.
Charged sigma hyperon leptonic decays, 18: 24402 (TID-19033)
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High-performance water plants, 18: 24901 (NP-13900(Sect.8))
Material and design considerations in PM-1 vessel, 18: 24897 (NP-13900(Sect.2))
Metallurgical examination of PM-1 control rod drive system pressure thimble, 18: 24890 (MND-M-3088 & Add.1)
PM advanced core designs, 18: 24899 (NP-13900(Sect.4))
PM-1 plant packaging, 18: 24896 (NP-13900(Sect.1))
Portable nuclear power plants, 18: 24900 (NP-13900(Sect.6))
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Fuel cycles in organic moderated reactors, 18: 24904 (NP-13904)
Heat transfer during film condensation of liquid metal vapor, 18: 23768 (MIT-2995-1)
MHD power generation, 18: 24359 (ANL-6802(p.101-9))
Plasma measurements on IMP-A, 18: 24749 (CONF-521-2)
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Construction and manner of operation of neutron refractometer, 18: 23838 (NP-13930(p.122-4))
Nuclear physics experiments on the FRM, 18: 24961 (NP-13930(p.80-103))
Scattering of subthermal neutrons on lattice defects, 18: 24194 (NP-13930(p.116-17))

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Prog. rpt. on single-crystal deformation in zone-refined Be, 7/62–6/63, 18: 24134 (NMI-1257)
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Dry friction in gas bearings and shaft seals, 18: 23742 (TID-7690 (p.106-20))

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Gas-bearing circulators in Dragon, 18: 24917 (TID-7690(p.207-18))

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Kinetics of thermal decomposition of biphenyl, 18: 23570 (ORNL-3602)

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Master analytical manual, 18: 23410 (TID-7015(Suppl.6))

MSRE capsule irradiation experiment, 18: 24907 (ORNL-TM-870)

Multi-pad gas bearings, 18: 23746 (TID-7690(p.263-72))

Postirradiation evaluation of stainless steel-clad plate-type specimens, 18: 24195 (ORNL-TM-815)

Primary circulators for A.V.R. Brown Boveri-Krupp reactor, 18: 24912 (TID-7690(p.1-15))

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Recovering U by solvent extraction from solution of chlorination products, 18: 23703 (ORNL-TM-789)

Recovery of Pu from irradiated Pu–Al alloy, 18: 23702 (ORNL-3566)

Removal of Hg from radioactive waste solutions, 18: 24977 (ORNL-TM-827)

Removal of radioiodine vapor from gases, 18: 23386 (CONF-12-3)

Seal systems for GCR, 18: 23743 (TID-7690(p.121-42))

Separation and recovery of U and Pu from fission products, 18: 23704 (ORNL-TM-828)

Sessile drops of molten halides on graphite and metals, 18: 23437 (CONF-322-12)

Shielding for ANP program, 18: 24934 (ANP-53)

Spleen white pulp germinal centers during primary immune response, 18: 24998 (ORNL-3595)

Stability of flexible rotor subjected to rotary damping, 18: 23749 (TID-7690(p.313-30))

Synthesis and infrared absorption of N,N′,N″-trimethylborazine, 18: 23571 (ORNL-TM-860)

Temperature distribution in EGCR vessel cooling compressor, 18: 24915 (TID-7690(p.166-75))

Tests using hydrostatic gas bearings, 18: 23748 (TID-7690(p.303-12))

Turbo-circulator for GCR-4 reactor system, 18: 24913 (TID-7690(p.16-75))

Welded-metal-bellows shutdown seals, 18: 24823 (TID-7690(p.176-88))

Zr–U processing equipment contamination and decontamination, 18: 23705 (ORNL-TM-837)

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Beam tube experiments with a divided core, 18: 24849 (NP-13930(p.130))

Suppression of reflections in rotating-crystal spectrometer, 18: 23880 (NP-13930(p.127))

P

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Energy straggling in series of absorbing layers, 18: 24297 (AFCRL-63-558)

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Measurement of H-alpha flare spectrograms, 18: 24271 (NP-13803)

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Statistics of solar flares. I., 18: 24270 (NP-13802)

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Fluorescent light emitted by aqueous solution in γ radiation field, 18: 23580 (PAN-488/XVII)

Fractional parentage coefficients $(p^n/p^{n-1},p)$, 18: 24621 (PAN-449/VII)

Measuring thickness of thin coatings on steel sheets, 18: 24046 (PAN-485/I-A)

SIUP geometrical reconstruction program, 18: 23887 (PAN-474/VI)

Window amplifier, 18: 23839 (PAN-479/I)

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Prog. rpt. on emissivity of materials, final, 7/59–12/62, 18: 24138 (PWA-2206(Vol.I))

Prog. rpt. on thermionic generator, 1–3/64, 18: 24370 (PWA-2337)

PRATT AND WHITNEY AIRCRAFT DIV., UNITED AIRCRAFT CORP. CONNECTICUT AIRCRAFT NUCLEAR ENGINE LAB., MIDDLETOWN.

Effects of radiation on Nb–0.6% Zr alloy, 18: 24196 (PWAC-278)

Harmonic drive development, 18: 24908 (PWAC-412)

LCRE auxiliary systems, 18: 24909 (PWAC-416)

LCRE fission-counter preamplifier, 18: 24822 (PWAC-427)

LCRE neutron sensor, 18: 23888 (PWAC-424)

PRESSURE TECHNOLOGY CORP. OF AMERICA, WOODBRIDGE, N. J.

Deformation characteristics of Be and W, 18: 24118 (AD-418388)

PRINCETON UNIV., N. J.

Nuclear moments of C-11 from $^3P_2$ and $^3P_1$ hyperfine structure, 18: 24622 (PUC-1963-126)

Spectral density of radiation scattered by non-equilibrium plasma, 18: 24752 (MATT-217)

PUBLIC HEALTH SERVICE, WASHINGTON, D. C.

Radiological Health Data, Vol. V, No. 5, 18: 23804

PURDUE UNIV., LAFAYETTE, IND.

Contact resistance of Fe-plated Pb telluride contact, 18: 24357 (ANL-6802(p.78-86))

R

RADIO CORP. OF AMERICA. SPECIAL ELECTRONIC COMPONENTS

DIV., LANCASTER, PENNA.
Prog. rpt. on thermionic converter for nuclear applications, 10/9/62–9/30/63, 18: 24369 (NP-13892)
RAND CORP., SANTA MONICA, CALIF.
Effect of compressibility on stability of fluid interface, 18: 24999 (RM-3953-AEC)
Fission-electric cell project, 18: 24371 (RM-3908-PR)
Non-linear interactions of EM fields with matter, 18: 24215 (RM-4093-PR)
RENSSELAER POLYTECHNIC INST., TROY, N. Y.
Fission cross section of Pu-241, 18: 24586 (IDO-16976)
Non-aqueous $AgNO_3$ solutions: electrical conductance, 18: 25000 (RPI-1999-3)
Prog. rpt. on linear accelerator project, 1–3/64, 18: 24571 (RPI-328-6)
RESEARCH AND TECHNOLOGY DIV. AIR FORCE MATERIALS LAB., WRIGHT-PATTERSON AFB, OHIO.
Effects of annealing and grain size in powder-metallurgy W, 18: 24123 (ASD-TDR-63-676)
Vacuum-arc melting of refractory metals, 18: 24070 (RTD-TDR-63-4089)
RESEARCH TRIANGLE INST., DURHAM, N. C.
Damage assessment and data base on shelter needs, 18: 23826 (NP-13942)
REYNOLDS ELECTRICAL AND ENGINEERING CO., INC., LAS VEGAS, NEV.
Strontium-90 determination, 18: 23408 (NVO-162-8)
ROCHESTER, N. Y. UNIV.
Genetic studies in blue-green algae, 18: 24997 (NYO-3046-1)
Nuclear interactions of 900-Mev α particles, 18: 24619 (NYO-10269)
Relativistically invariant position operators for spinning particles, 18: 24401 (NYO-10270)
ROCHESTER, N. Y. UNIV. ATOMIC ENERGY PROJECT.
Addition of modes of radiation injury in producing lethality, 18: 23245 (UR-654)
Determination of total I in I^{131}-iodide preparations, 18: 23413 (UR-644)
Gross developmental anomalies induced by Sr-90 in rat embryo, 18: 23244 (UR-643)
Renal function in Nb-poisoned rats, 18: 23203 (UR-646)
Retention of Sr-90 in rats, 18: 23243 (UR-642)
ROME. UNIVERSITÀ.
Prog. rpt. on ionic mobility in cold plasmas, 12/61–11/62, 18: 24739 (AD-417496)

S

SAINT MARGARET'S HOSPITAL, BOSTON.
Prog. rpt. on effect of irradiation on phagocytic activities of cells, 18: 23242 (TID-20379)
SANDIA CORP., ALBUQUERQUE, N. MEX.
Prog. rpt. on earth resistance to projectile impact, 10/14/63–3/1/64, 18: 25001 (SC-DC-64-459)
Re-entry flight demonstration number one, 18: 24941 (SC-RR-64-501)
SANDIA LAB., ALBUQUERQUE, N. MEX.
Error analysis of two-component strain-gage balance, 18: 25002 (SC-TM-64-8)
SAVANNAH RIVER OPERATIONS OFFICE, AEC.
Prog. rpt. on D_2O power reactor program, 4/64, 18: 24910 (SRO-101)
SLOAN-KETTERING INST. FOR CANCER RESEARCH, NEW YORK.
Amino acids as punctuation in genetic code of DNA, 18: 25011 (TID-20348)
SOCIÉTÉ ALSTHOM, PARIS.
Prog. rpt. on nuclear vapotron, 5–9/62, 18: 24862 (EURAEC-541)
Prog. rpt. on nuclear vapotron, 10–12/62, 18: 24863 (EURAEC-694)
SOCIÉTÉ ANONYME DES FORGES ET ATELIERS DU CREUSOT, LE CREUSOT, FRANCE.
Prog. rpt. on hydrogen embrittlement tests on steel, 4–6/63, 18: 24153 (EURAEC-1002)
Prog. rpt. on variation of transformation points, 10–12/63, 18: 24152 (EURAEC-1001)
SOCIÉTÉ BELGE DE CHIMIE NUCLÉAIRE, BRUSSELS.
Prog. rpt. on nuclear vapotron, 1–3/63, 18: 24864 (EURAEC-770)
Prog. rpt. on processing radioactive water and residues, 1/15–3/31/62, 18: 24980 (EURAEC-300)
Prog. rpt. on water treatment and radioactive residues, 4–6/61, 18: 24979 (EURAEC-202)
SOCIÉTÉ RATEAU, LA COURNEUVE, FRANCE.
Construction and operation of gas-bearing compressors, 18: 23744 (TID-7690(p.219-35))
Multi-pad gas bearings, 18: 23746 (TID-7690(p.263-72))
SOUTHWEST RESEARCH INST., SAN ANTONIO.
Prog. rpt. on nondestructive testing instrumentation for reactor pressure vessels, 1–3/64, 18: 23780 (SWRI-1243-11)
SPACE SCIENCES, INC., WALTHAM, MASS.
Plasma with electric, magnetic and fluiddynamic fields, 18: 24746 (ARL-64-34)
STOCKHOLM. UNIV.
Prog. rpt. on electronic structures and states of molecules and crystals, 3/62–2/63, 18: 24296 (AD-417517)
STUTTGART. TECHNISCHE HOCHSCHULE.
Inelastic scattering cross sections on Na-23 to 4 Mev, 18: 24597 (NP-13930(p.15))
SWEDEN. FÖRSVARETS FORSKNINGSANSTALT, STOCKHOLM.
Radioactivity measurements on food, 1962, 18: 23790 (NP-13828)
SWEDEN. KUNGLIGA KAROLINSKA MEDIKO-KIRURGISKA INSTITUTET, STOCKHOLM.
Radioactivity measurements on food, 1962, 18: 23790 (NP-13828)
SWEDEN. KUNGLIGA VETERINARHOGSKOLAN, STOCKHOLM.
Radioactivity measurements on food, 1962, 18: 23790 (NP-13828)
SWEDEN. STATENS LANTBRUKSFÖRSÖK, ULTUNA.
Radioactivity measurements on food, 1962, 18: 23790 (NP-13828)
SYDNEY. UNIV.
Collision damping of two-stream instabilities in plasma, 18: 24759 (NP-13950
Electrical conductivity of Lorentz gas, 18: 24761 (NP-13952)
Production of highly excited neutral atoms for injection into plasma devices. I., 18: 24757 (NP-13948)
Production of highly excited neutral atoms for injection into plasma devices. II., 18: 24758 (NP-13949)
Relaxation of fast ion in plasma, 18: 24760 (NP-13951)

T

TENNESSEE. UNIV., KNOXVILLE.
Seal systems for GCR, 18: 23743 (TID-7690(p.121-42))
Spleen white pulp germinal centers during primary immune response, 18: 24998 (ORNL-3595)
Temperature distribution in EGCR vessel cooling compressor, 18: 24915 (TID-7690(p.166-75))
TENNESSEE VALLEY AUTHORITY, OAK RIDGE, TENN.
Experimental Gas Cooled Reactor shaft seals, 18: 24914 (TID-7690 (p.143-65))
Radiological health manual for EGCR, 18: 23820 (EGCR-4)
TEXAS. UNIV., HOUSTON. M. D. ANDERSON HOSPITAL AND TUMOR INST.
Electron microscopic studies of isolated mammalian chromosomes, 18: 25008 (TID-19032)
THERMO ELECTRON ENGINEERING CORP., WALTHAM, MASS.
Prog. rpt. on additive converter studies, 9/63, 18: 24350 (AD-418278)
THOMPSON RAMO WOOLDRIDGE INC., CLEVELAND.
Propellant feed systems for ion engines, 18: 23754 (NASA-CR-51)
THOMPSON RAMO WOOLDRIDGE INC. TRW ELECTROMECHANICAL DIV., CLEVELAND.
Prog. rpt. on coated Nb alloys, final, 3/63–3/64, 18: 24068 (NP-13955)
Prog. rpt. on coatings for W, 11/15/63–2/15/64, 18: 24086 (NP-13958)
Prog. rpt. on containment of molten LiH, 1/62–10/63, 18: 24085 (NASA-CR-54053)
TORONTO. UNIV.
Mechanics of rarefied gases and plasmas, 18: 24764 (UTIAS-Rev-18)
TRACERLAB. DIV. OF LAB. FOR ELECTRONICS, INC., RICHMOND, CALIF.
Application of nuclear techniques to the manufacture of high-reliability printed circuit boards, 18: 23841 (TID-20183)

U

U.S.S.R. SOVET MINISTROV. GOSUDARSTVENNYI KOMITET PO

ISPOL'ZOVANIYU ATOMNOĬ ENERGII.

Calculation of weak self-oscillatory conditions in reactors, 18: 24850 (NP-13963)

Creep rate of Ni after prior deformation at 4.2°K, 18: 24136 (NP-13909)

Investigation of Ru-103 and Ru-106 content of mixture of fission products, 18: 23886 (NP-13965)

Movement of pores in solid body, 18: 24069 (NP-13957)

Neutron-neutron interaction in S-state, 18: 24398 (NP-13961)

New approach to theory of nucleus, 18: 24615 (NP-13959)

Peculiarities of partial waves near $J = I$ and asymptotics of amplitude of elastic scattering, 18: 24395 (NP-13872)

Search for light neutron nuclei, 18: 24616 (NP-13964)

UNION CARBIDE CORP. NUCLEAR DIV. Y-12 PLANT, OAK RIDGE, TENN.

Determination of Ni in Th metal, 18: 23414 (Y-1464)

X-ray fluorescence tables for topaz crystal, 18: 24216 (Y-1470-B)

UNION CARBIDE CORP. RESEARCH INST., TARRYTOWN, N. Y.

Electrical properties of transition-metal carbides and nitrides, 18: 24137 (NP-13944)

UNION OF SOUTH AFRICA. ATOMIC ENERGY BOARD, PRETORIA.

Bibliography on radioisotope applications in hydrology, 18: 24044 (NP-13931)

UNITED KINGDOM ATOMIC ENERGY AUTHORITY. AUTHORITY HEALTH AND SAFETY BRANCH, RISLEY, LANCS, ENGLAND.

Assessment of environmental hazard from fission-product releases, 18: 23816 (AHSB(S)R-64)

UNITED KINGDOM ATOMIC ENERGY AUTHORITY. PRODUCTION GROUP. CHAPELCROSS WORKS, ANNON, DUMFRIESSHIRE, SCOTLAND.

Biology of Solway Firth. XII., 18: 23180 (PG-Report-578)

Biology of Solway Firth. VIII., 18: 23785 (PG-Report-577)

UNITED KINGDOM ATOMIC ENERGY AUTHORITY. REACTOR GROUP. ATOMIC ENERGY ESTABLISHMENT, WINFRITH, DORSET, ENGLAND.

Graphical representation of data in Aldermaston and Winfrith nuclear data library, 18: 24987 (AEEW-M-426)

Monte Carlo computer program CEP for calculating collision probabilities in cuboids and finite cylinders, 18: 24377 (AEEW-M-442)

Pool boiling with reference to additives, 18: 23761 (AEEW-R-180)

Program PIP1 for solution of multigroup equations of method of collision probabilities, 18: 24378 (AEEW-R-326)

UNITED KINGDOM ATOMIC ENERGY AUTHORITY. RESEARCH GROUP. ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL, BERKS, ENGLAND.

Control of H-3 in D_2O in DIDO-class reactors, 18: 23812 (AERE-R-4528 (p.25-33))

Experience in fuel element cropping and irradiation ponds, 18: 23814 (AERE-R-4528(p.55-67))

Experience with beams from reactors, 18: 23813 (AERE-R-4528(p.49-53))

Focusing triple-axis spectrometer, 18: 23870 (AERE-R-4380)

Gas bubble growth on heating irradiated U, 18: 24187 (AERE-R-2935)

General consideration of health physics control, 18: 23810 (AERE-R-4528 (p.1-24))

Health physics control of research reactors, 18: 23809 (AERE-R-4528)

Monitoring techniques and radiation spectrometry in contamination control, 18: 23811 (AERE-R-4528(p.25-33))

Oxygen/metal ratios for U, Pu and (U,Pu) oxides, 18: 23403 (AERE-R-4608)

Portable shower cabinet, 18: 23808 (AERE-R-4084)

Shielding and sealing master-slave No. 7 manipulator, 18: 23753 (AERE-R-4085)

UNITED KINGDOM ATOMIC ENERGY AUTHORITY. RESEARCH GROUP. CHEMISTRY DIV., WOOLWICH OUTSTATION, ENGLAND.

Radioactivities in bones, 18: 23402 (AERE-R-4466)

UNITED KINGDOM ATOMIC ENERGY AUTHORITY. RESEARCH GROUP. CULHAM LAB., CULHAM, ABINGDON, BERKS, ENGLAND.

Bibliography on containment of plasma, 18: 24748 (CLM-Bib-4)

UNITED KINGDOM ATOMIC ENERGY AUTHORITY. RESEARCH GROUP. WANTAGE RESEARCH LAB., WANTAGE, BERKS, ENGLAND.

Activity induced in food by irradiation, 18: 23815 (AERE-R-4601)

Standardization of Zr^{95}–Nb^{95}, 18: 24042 (AERE-R-4555)

Use of pump to reduce mixing length in dilution method of flow measurement, 18: 23762 (AERE-R-4623)

UNITED KINGDOM ATOMIC ENERGY AUTHORITY. WEAPONS GROUP. ATOMIC WEAPONS RESEARCH ESTABLISHMENT, ALDERMASTON, BERKS, ENGLAND.

Automatic processing and evaluation of film badge dosimeter, 18: 23818 (AWRE-O-93/63)

UNITED NUCLEAR CORP. DEVELOPMENT DIV., WHITE PLAINS, N. Y.

Minimum-weight proton shields, 18: 24805 (UNC-5049)

Prog. rpt. on fuel cycle development, 10/62–6/63, 18: 24860 (UNC-5071)

Prog. rpt. on thermodynamics of U–N system, annual, 1/64, 18: 23454 (UNC-5077)

UNITED STATES–EURATOM JOINT RESEARCH AND DEVELOPMENT PROGRAM.

Joint Research and Development Quarterly Digest, Vol. 3, No. 4, 18: 25036

Prog. rpt. on diffusion and precipitation of H in Zr, 10–11/63, 18: 24131 (EURAEC-921)

Prog. rpt. on heat transfer and stability in BWR, 10/63–1/64, 18: 24883 (EURAEC-963)

Prog. rpt. on high-performance UO_2 programs, 1–3/64, 18: 24855 (GEAP-3771-12)

Prog. rpt. on hydraulic ball control system, 1–3/64, 18: 24820 (GNEC-337)

Prog. rpt. on hydrogen embrittlement tests on steel, 4–6/63, 18: 24153 (EURAEC-1002)

Prog. rpt. on nondestructive testing instrumentation for reactor pressure vessels, 1–3/64, 18: 23780 (SWRI-1243-11)

Prog. rpt. on nuclear vapotron, 5–9/62, 18: 24862 (EURAEC-541)

Prog. rpt. on nuclear vapotron, 10–12/62, 18: 24863 (EURAEC-694)

Prog. rpt. on nuclear vapotron, 1–3/63, 18: 24864 (EURAEC-770)

Prog. rpt. on processing radioactive water and residues, 1/15–3/31/62, 18: 24980 (EURAEC-300)

Prog. rpt. on Pu recycling, 1963, 18: 24865 (EURAEC-992)

Prog. rpt. on shaping and irradiation of UC, 10–12/63, 18: 24072(T,R) (EURAEC-934)

Prog. rpt. on stress-corrosion cracking of stainless steels, 1–3/64, 18: 24125 (CEND-3256-209)

Prog. rpt. on UO_2 fuel systems, 4/64, 18: 24854 (CEND-2863-211)

Prog. rpt. on variation of transformation points, 10–12/63, 18: 24152 (EURAEC-1001)

Prog. rpt. on water treatment and radioactive residues, 4–6/61, 18: 24979 (EURAEC-202)

Prog. rpt. on Zr–V alloys, 10–12/62, 18: 24150 (EURAEC-538)

Structural properties of stainless steels, 18: 24151 (EURAEC-986)

V

VERBAND DEUTSCHER PHYSIKALISCHER GESELLSCHAFTEN E. V., BRUNSWICK.

Angular distribution inelastic diffusion of neutrons in C, 18: 24603 (NP-13930(p.51-3))

Back-scattering proton spectrometer for measuring fast neutron spectra, 18: 23883 (NP-13930(p.147-57))

Beam tube experiments with a divided core, 18: 24849 (NP-13930(p.130))

Cold neutrons by total reflection, 18: 24569 (NP-13930(p.119-20))

Comparison of coherent scattering lengths on a neutron interferometer, 18: 23878 (NP-13930(p.76-7))

Conference on neutron physics, Karlsruhe, 10/63, 18: 24567 (NP-13930)

Construction and manner of operation of neutron refractometer, 18: 23838 (NP-13930(p.122-4))

Cross section measurements on Pd for epithermal neutron energies, 18: 24609 (NP-13930(p.112-13))

Cross sections of nuclear reactions caused by neutrons, 18: 24601 (NP-13930(p.41-2))

Energy dependence of neutron cross sections, 18: 24602 (NP-13930 (p.43-9))

Inelastic scattering cross sections on Na-23 to 4 Mev, 18: 24597 (NP-13930(p.15))

Inelastic scattering of neutrons on V hydride, 18: 24605 (NP-13930 (p.59-71))

Interaction cross sections for slow neutrons, 18: 24606 (NP-13930

(p.73-4))
Karlsruhe Van de Graaff project for fast neutrons, 18: 24246 (NP-13930 (p.137-8))
Measurement of (n,γ) cross sections and resonance integrals, 18: 24608 (NP-13930(p.110-11))
Measurement of the isomeric splitting ratio of In resonances, 18: 24610 (NP-13930(p.114-15))
Neutron flash tube—a strong, pulsed neutron source, 18: 24570 (NP-13930(p.141-3))
Neutron generator with duoplasmatron ion source, 18: 24247 (NP-13930 (p.140))
Neutron-induced reactions in Si semiconductor counters, 18: 24599 (NP-13930(p.26-38))
Neutron interaction cross sections on Si, 18: 24600 (NP-13930(p.39-40))
New work on level densities, 18: 24596 (NP-13930(p.14))
Nuclear physics experiments on the FRM, 18: 24961 (NP-13930(p.80-103))
Nuclear physics investigations by the (n,γ) reaction, 18: 24607 (NP-13930(p.104-8))
Nuclear reactions and optical nuclear model, 18: 24594 (NP-13930 (p.1-5))
Nuclear reactions induced by 14.7-Mev neutrons, 18: 24613 (NP-13930(p.139))
Passage of polarized neutrons through magnetized Fe, 18: 24568 (NP-13930(p.78-9))
Precision crystal spectrometer for slow neutrons, 18: 23881 (NP-13930 (p.128-9))
Production investigations for 14-Mev neutrons from $H^3(d,n)He^4$, 18: 24604 (NP-13930(p.54-5))
Reaction (d,n) on Be-9, B-10, B-11, Si-28 and P-31, 18: 24611 (NP-13930(p.132-3))
Reaction $Ti^{48}(p,n)V^{48}$, 18: 24612 (NP-13930(p.134))
Rotating-crystal spectrometer for scattering experiments with slow neutrons, 18: 23879 (NP-13930(p.126))
Scattering of slow neutrons on rotating molecules, 18: 24299 (NP-13930(p.56-7))
Spectrometry of fast neutrons with semiconductors, 18: 23884 (NP-13930 (p.159-77))
Statistics of nuclear level intervals and widths, 18: 24598 (NP-13930 (p.17-25))
Suppression of reflections in rotating-crystal spectrometer, 18: 23880 (NP-13930(p.127))
Threshold detectors for fast neutron fluxes, 18: 23885 (NP-13930 (p.178-80))
Time-of-flight spectrometer for fast neutrons, 18: 23882 (NP-13930 (p.144-6))
Transmission coefficients and absorption cross sections according to optical model, 18: 24595 (NP-13930(p.6-13))

VIENNA. UNIVERSITÄT.
Prog. rpt. on separation of U and Th, 10/63–4/64, 18: 23707 (TID-20609)

W

WASHINGTON UNIV., ST. LOUIS.
Prog. rpt. on nuclear physics, 7/1–10/15/64, 18: 24239 (AFOSR-J1340)

WESTINGHOUSE ELECTRIC CORP. ATOMIC POWER DIV., PITTSBURGH.
Unit cell homogenization for reactor depletion studies, 18: 24861 (WCAP-6060)

WESTINGHOUSE ELECTRIC CORP. BETTIS ATOMIC POWER LAB., PITTSBURGH.
Calibration of temperature-sensing elements reactor plant portion, 18: 24918 (WAPD-PWR-TE-159(Rev.))
Monte Carlo calculations of reactor eigenvalues, 18: 24818 (WAPD-T-1649)
WIGLE program for solution of two-group space-time diffusion equations in slab geometry, 18: 24572 (WAPD-TM-416)

WESTINGHOUSE ELECTRIC CORP. SMALL STEAM AND GAS TURBINE DIV., LESTER, PENNA.
Turbo-circulator for GCR-4 reactor system, 18: 24913 (TID-7690(p.16-75))

WISCONSIN. UNIV., MADISON.
Producing supersonic high electron density plasma, 18: 24743 (ANL-6802(p.29-36))
Solar energy conversion, 18: 24353 (ANL-6802(p.24-5))

Y

YALE UNIV., NEW HAVEN.
Analysis of nucleon transfer data, 18: 24618 (NYO-1807-8)
Application of time-lag models to natural populations, 18: 25012 (TID-20579)
Direct-interaction processes and simple approximation methods, 18: 24400 (NYO-1807-9)
Limited applicability of nucleon tunneling theory, 18: 24617 (NYO-1807-7)

PERSONAL AUTHOR INDEX

Each entry after an author's name is a shortened version of the title of the report or article, followed by the *NSA* volume and abstract number. Report numbers are given in parentheses.

The phrase "Progress report" is abbreviated as "Prog. rpt.," permitting a more rapid and complete alphabetical arrangement of the titles without changing the location of the progress report titles in relation to the other titles.

Because of problems involving the mechanical preparation of this index, all accent marks are omitted. The following changes in spelling have been introduced to reduce some of the confusion which might result from omitting the accents:

ä becomes ae
ö oe
ø oe
ü ue (except in transliterated Chinese names)

A

ABE, Hitoshi, High-temperature irradiation of polyvinyl alcohol, 18: 24197 (AEC-tr-6316(p.114-17))
ABE, Hitoshi, Post heating of polyvinyl alcohol irradiated at room temperature, 18: 24198 (AEC-tr-6316(p.118-20))
ABE, Toshihiko, Formation of radiation-induced graft polymers, 18: 23660 (AEC-tr-6316(p.672-5))
ABE, Toshihiko, Radiation-induced oxidation of phenyl cyclohexane, 18: 23656 (AEC-tr-6316(p.623-39))
ABERG, Bertil, Radioactivity measurements on food, 1962, 18: 23790 (NP-13828)
ABONYI, I., Basic equations of MFD in anisotropic media, 18: 24768
ABRIKOSOV, A. A., Lower critical field of thin layers of superconductors of second group, 18: 24562
ABSON, W., Semiconductor detectors of nuclear radiations, 18: 23902
ADAMS, J. A. S., Alpha-activity at 4.4 Mev in natural Th, 18: 23802
ADAMS, Robert E., Removal of radioiodine vapor from gases, 18: 23386 (CONF-12-3)
ADENIS, L., Intravenous injections of Guerin epithelioma. VI., 18: 23264
AFANAS'EV, Yu. A., Thermochemical study of $UO_2(NO_3)_2$–H_2O–TBP system, 18: 23713
AFANAS'EVA, V. I., Classification of geomagnetic storms, 18: 24530
AFANAS'EVA, V. I., Geoactivity and its possible causes, 18: 24528
AGRINIER, B., Analysis of tracks created in Pb-plate spark chamber, 18: 23973
AHIMAZ, F., Prog. rpt. on reactor containment, 2–4/64, 18: 24824 (TID-20613)
AHLUWALIA, H. S., Intensity of cosmic radiation and EM states of interplanetary space, 18: 24345
AHMAD, Iqbal, Non-aqueous $AgNO_3$ solutions: electrical conductance, 18: 25000 (RPI-19993)
AHMADZADEH, Akbar, Analysis of NN and $N\bar{N}$ total cross sections, 18: 24452
AKASOFU, S.-I., Development of auroral substorm, 18: 24542
AKASOFU, S.-I., Dynamics of the aurora. I., 18: 24538
AKHIEZER, I. A., Interaction between charged particles and nonequilibrium plasma, 18: 24802
AKITYA, P. K., Distortion in emulsion and influence on measurements, 18: 23950
ALBENDOV, A. A., Determination of Zr by microperiodate method, 18: 23420
ALBLINGER, Judy, Segregation of structural elements during cell division, 18: 23163 (ANL-6823(p.178-88))
ALBLINGER, Judy A., Plastid development and chlorophyll production in Chlorella mutant C-10, 18: 23196 (ANL-6823(p.161-4))
ALBOLD, E., Measurement of the isomeric splitting ratio of In resonances, 18: 24610 (NP-13930(p.114-15))
ALBOLD, E., Precision crystal spectrometer for slow neutrons, 18: 23881 (NP-13930(p.128-9))
ALDER, J. C., Angular distribution inelastic diffusion of neutrons in C, 18: 24603 (NP-13930(p.51-3))
ALEKSEEVA, K. L., Ionization-momentum dependence for electrons, 18: 23953
ALEXANDER, G., Lifetime measurement of Σ^0 through its weak interaction, 18: 24442
ALEXANDER, John M., Recoil range straggling of heavy ion reaction products in He, 18: 24734
ALEXANDRE, B., Thin-film fast magnetic memories, 18: 23862
ALIBERT, Anny, Fructose activity in kidney after $UO_2(NO_3)_2$ intoxication, 18: 23213
ALIKHANYAN, A. I., Ionization energy losses by fast electrons in thin polystyrene layers, 18: 24702
ALLAIN, Claude, Ionographic study of 15.9-Mev neutrons, 18: 24578
ALLEN, Frank J., Neutron reflection and flux versus depth for Al, 18: 24564 (BRL-1238)
ALLEN, John W., Apparatus for transporting hot radioactive material, 18: 23759
ALMAGRO, J., Reversible and irreversible processes on dropping Hg electrode. XVIII., 18: 23463
ALMAGRO, V., Reversible and irreversible processes on dropping Hg electrode. XVIII., 18: 23463
ALMENAS, Aldona, Biosynthesis of methionine in *Saccharomyces cerevisiae*, 18: 23193 (ANL-6823(p.128-40))
AMALDI, U., Use of internal beam of synchrotron for study of reaction (e,e'p), 18: 24243 (ISS-63/42)
AMAMIYA, Ayao, ESR absorption of irradiated alcohols, 18: 23649 (AEC-tr-6316(p.538-50))
AMAMIYA, Ayao, Graft copolymerization of polyethylene with propylene and anhydrous SO_2, 18: 23642 (AEC-tr-6316(p.481-97))
Amaral, C. Marcio do
see *Marcio do Amaral, C.*
AMATO, I., Influence of local variations in O/U ratio during UO_2 pellet sintering, 18: 24109
AMBERG, Stanley Louis, Fuel cycles in organic-moderated reactors, 18: 24859 (TID-20593)
AMSBURY, W. P., X-ray fluorescence tables for topaz crystal, 18: 24216 (Y-1470-B)
AMYOT, L., Fast neutron multiplication factor, 18: 24846 (EUR-1618.e)
ANAND, S., Small-angle scattering of low-energy γ rays from atomic electrons, 18: 24412
ANBAR M., Isotope exchange in gaseous N under irradiation, 18: 23680

ANDERSEN, A. C., Reproductive ability of aging x-irradiated and sham-treated female beagle, 18: 23341
ANDERSEN, A. C., Syndromes affecting reproduction in normal and x-irradiated female beagles, 18: 23345
ANDERSON, A., Far infrared spectra of molecular crystals. I., 18: 23558
ANDERSON, Cleve Richard, Method for the control of a nuclear reactor, 18: 24842
ANDERSON, D. C., Hydrodynamics of underground nuclear explosions, 18: 23783 (NP-13943(p.209-14))
ANDERSON, R. H., ESADA fuel fabrication, 18: 23404 (AI-8700(Vol.V))
ANDERSON, T., High-temperature optical extensometer, 18: 25017 (UCRL-7405)
ANDERSSON-LINDSTROEM, G., Neutron-induced reactions in Si semiconductor counters, 18: 24599 (NP-13930(p.26-38))
ANDO, Wataru, Radiation-induced isomerization of butene-2, 18: 23666
ANDO, Wataru, Radiation-induced isomerization of butene-2, 18: 23667
ANDO, Wataru, Radiation-induced additions of H_2S to olefins, 18: 23668
ANDRASCHKO, Johanna, Enrichment of U on peat, 18: 23806
ANDREEV, P. F., Processes and reaction products of high-molecular-weight compounds with inorganic salts. III., 18: 23542
ANDREEVA, I. V., Processes and reaction products of high-molecular-weight compounds with inorganic salts. III., 18: 23542
ANDREJEV, K. K., Thermal decomposition and combustion processes in explosives, 18: 25027 (LA-tr-64-2)
ANDRIAMBOLOLONA, Raoelina, Coupling constants of mesons with nucleons, 18: 24411
Angeles Contreras, Ma. de los
see *de los Angeles Contreras, Ma.*
ANGEL GARCIA ONTIVEROS, F., Determination of arrival directions of EAS, 18: 23965
ANIKIN, V. S., Gamma-spectrometric method of analysis of I-131 and I-132, 18: 23432
ANISOVICH, V. V., Nature of low-energy interaction of π mesons, 18: 24474
ANISOVICH, V. V., Three-particle production near threshold when two particles interact resonantly, 18: 24479
Anta, Maria do Carmo
see *do Carmo Anta, Maria*
ANTHONY, Ronald Desmond, Improvements in cooling of concrete vessels, 18: 24830
ANTIER, G., Thin-film fast magnetic memories, 18: 23862
ANTOKU, Shigetoshi, Exposure dose by diagnostic x ray in obstetrics, 18: 23831
APALIN, V. F., Number of neutrons emitted by U-235 fission fragments, 18: 24701
APPA RAO, M. V. K., Nuclear interactions of 900-Mev α particles, 18: 24619 (NYO-10269)
APPLEBY, E. R., Production of UO_2 crystals, 18: 23458 (HW-tr-71)
ARAJS, S., Thermal conductivity of Sc between 5 and 320°K, 18: 24182
ARAKI, Kazuo, Graft polymerization of vinyl monomers, 18: 23657 (AEC-tr-6316(p.640-9))
ARAKI, Kunio, ESR of carbon black, 18: 23401 (AEC-tr-6316(p.660-8))
ARAKI, Kunio, Formation of radiation-induced graft polymers, 18: 23660 (AEC-tr-6316(p.672-5))
ARAKI, Kunio, Radiation-induced polymerization of acrolein diethyl ether, 18: 23641 (AEC-tr-6316(p.471-80))
ARAKI, Kunio, Radiation-induced oxidation of phenyl cyclohexane, 18: 23656 (AEC-tr-6316(p.623-39))
ARAKI, Kunio, Radiation-induced graft polymerization on cellulose, 18: 23658 (AEC-tr-6316(p.650-9))
ARAKI, Kunio, Radiation-induced addition reactions of polyhalides, 18: 23659 (AEC-tr-6316(p.669-71))
ARDACHEV, I. V., Chemical ripening of R emulsion, 18: 23497
ARDACHEV, I. V., Possibility of nuclear emulsion having changing sensitivity, 18: 23923
ARIFOV, U. A., Cathodic sputtering of W by means of K ions, 18: 24776
ARMBRUSTER, P., Nuclear physics experiments on the FRM, 18: 24961 (NP-13930(p.80-103))
ARMSTRONG, D. D., 4^- State in Zr-90, 18: 24663
ARNAUD, Y., Localization of consecutive activated zones after exposure to high neutron flux, 18: 23890 (SCPRI(S)-92)
ARNDT, R. A., Nucleon-nucleon elastic scattering matrix. I., 18: 24403 (UCRL-7563-T)
ARNELL, S. E., Tentative level schemes of Mn-51 and Mn-53, 18: 24660
ARONIN, L. R., Prog. rpt. on single-crystal deformation in zone-refined Be, 7/62–6/63, 18: 24134 (NMI-1257)
ARORA, R. C., Cation-exchange resin for total anion analysis of solutions containing Be(II) ion, 18: 23423
ARTAMONOVA, E. P., Thorium acetates, 18: 23543
ASCOLI, A., Rehomogenization kinetics of irradiation-segregated Cu–Ni, 18: 24208
ASCOLI-BARTOLI, U., Study of plasma refractivity, 18: 24783
ASKWYTH, W. H., Prog. rpt. on emissivity of materials, final, 7/59–12/62, 18: 24138 (PWA-2206(Vol.I))
ATHERTON, D. R., Sr^{90} + Y^{90} bremsstrahlung efficiency in bone, 18: 23173
ATKINSON, G. F., LCRE fission-counter preamplifier, 18: 24822 (PWAC-427)
ATKINSON, R. d'E., Energy-momentum tensor for collapsing stars, 18: 24291
AUBRET, C., Fast transistorized electronic complex, 18: 24266
AUCHAPT, Pierre Raymond, Solvent purification in plants treating irradiated fuels, 18: 23698 (CEA-R-2404)
AUDI, M. N., Fuel loading for Elk River second core, 18: 24875 (ACNP-64536)
AUERBACH, Harry, Dose to gonads from injected Sr-90 and Y-90, 18: 23185 (ANL-6823(p.76-80))
AUERBACH, Harry, Effects of Pu injected subcutaneously in rat, 18: 23232 (ANL-6823(p.81-5))
AUMANN, D. C., Activation determination of Li, 18: 23427
AUMANN, D. C., Determination of O-18 concentration in water, 18: 23426
AURICH, F., High-purity Ge—surface conduction and carrier life, 18: 25030 (ORNL-tr-120)
AUSTERMAN, S. B., Electron microscopy of β beryllia, 18: 23563
AVRIL, M., Four-channel digital commutator, 18: 23855
AXFORD, T. H., Neutron slowing-down spectra in Be and BeO, 18: 24576
AYRES, Robert U., Aspects of environment resulting from nuclear war. II., 18: 23821 (HI-303-RR)
AYRES, Robert U., Aspects of environment resulting from nuclear wars. II, Annex IV., 18: 23822 (HI-303-RR/A-IV)
AYRES, Robert U., Aspects of environment resulting from nuclear wars. II, Annex III, 18: 23178 (HI-303-RR/A-III)
AYUKHANOV, A. Kh., Cathodic sputtering of W by means of K ions, 18: 24776
AZHAZHA, V. M., Creep rate of Ni after prior deformation at 4.2°K, 18: 24136 (NP-13909)
AZUMA, Toshio, Delayed neutron yield from U target bombarded by electrons, 18: 24574
AZUMA, Toshio, Measurement of short-lived isotope, 18: 24637
AZUMA, Tosio, Beta spectra of Ce-144, 18: 24222
AZUMA, Toskio, Liquid flowing neutron monitor, 18: 23896

B

BABALA, Dusan, Temperature measurements of neutrons in thermal column of VVR-S, 18: 24970
BABULE, Rene, Moderator structure for a nuclear reactor, 18: 24838
BACHHUBER, C. G., Detection of low-intensity radiations with nuclear emulsions, 18: 23921
BACKENSTOSS, G., Forward production of photons from 9-Bev π-p interactions, 18: 24417
BACON, G. E., Crystallographic study of solid benzene, 18: 23575
BACQ, Z. M., Radioprotective effects of alkaline earth chlorides on barley, 18: 23368
BAGGE, E., Back-scattering proton spectrometer for measuring fast neutron spectra, 18: 23883 (NP-13930(p.147-57))
BAGGE, Erich, Method for the extraction of Pu or U-233, 18: 24929
BAGRETSOV, V. F., Separating Sr-90 and Y-90 by means of gelatin foam, 18: 23735
BAIERLEIN, K., Scattering of subthermal neutrons on lattice defects, 18: 24194 (NP-13930(p.116-17))
BAILEY, G. F., Water–graphite relationships at constant moderation, 18: 24888 (HW-SA-3507)
BAILEY, M., Biology of Solway Firth. VIII., 18: 23785 (PG-Report-577)
BAILY, Norman A., Lithium-drifted Si p-i-n junction as x and γ dosimeter, 18: 23967

BAINARD, W. D., Water quality monitoring system for NPR, 18: 24932 (HW-SA-3018)
BAIR, J. K., Scattering (n,d) and search for dineutron effects, 18: 24444
BAKH, E. G., Isotopic exchange of H in hydrocarbons on rare earth oxides. II., 18: 23573
BAKH, N. A., Free-radical reactions during interaction of O with irradiated palmitate, 18: 23670
BAKOV, A. T., Gamma rays from radiative capture of fast neutrons in Na and Cu, 18: 24699
BALANDIN, A. A., Catalytic dehydration of cyclohexanol over MgSO$_4$ containing Pa-231, 18: 23672
BALASHOV, V. L., Separation of Ba and Sr by exchange, 18: 23734
BALASHOV, V. V., Coupling between shell model excitations and cluster excitations in light nuclei, 18: 24588 (JINR-P-1595)
BALDELLI, B., Inactivation of aphthous virus by radiation, 18: 23246 (AERE-Trans-1000)
BALE, William F., Determination of total I in I-131-iodide preparations, 18: 23413 (UR-644)
BALIS, M. E., Amino acids as punctuation in genetic code of DNA, 18: 25011 (TID-20348)
BALL, R. M., Reactor physics startup test of Indian Point reactor, 18: 24877 (BAW-189)
BALLONOFF, Larry B., Effect on catalase of compounds related to aminotriazole, 18: 23187 (ANL-6823(p.91-8))
BALLONOFF, Larry B., Reduction of erythrocyte catalase level. II., 18: 23186 (ANL-6823(p.86-90))
BALLOU, J. E., Distribution and retention of Pu-239 and Np-237 in rat adrenal, 18: 23221
BANACH, H. J., LCRE auxiliary systems, 18: 24909 (PWAC-416)
BANDER, Myron, Low-energy neutron-neutron scattering parameters, 18: 24451
BANKOFF, S. G., Asymptotic growth of bubble, 18: 23774
BARANGER, Michel, Nuclear deformations in pairing-plus-quadrupole model I, 18: 24614 (NP-13941)
BARANOV, V. Yu., Role of diffusion and viscous friction in plasma acceleration, 18: 24795
BARASHENKOV, V. S., Inelastic interactions of particles at high energies, 18: 24384 (JINR-P-1577)
BARASHENKOV, V. S., Verification of dispersion relations in small-angle- and high-energy region, 18: 24386 (JINR-P-1598)
BARBER, R. C., Mass effect corresponding to nuclear deformation in region N ~ 90, 18: 24681
BARBER, Stanley A., Effect of soil moisture and Rb concentration on Rb-86 uptake, 18: 23227
BARBER, W. C., Excitation of giant resonance in C-12 and O-16, 18: 24671
BARBER, W. C., Form factors for strong M1 transitions in light nuclei, 18: 24675
BARCHUK, I. F., Performance possibilities and operating experience with water/water reactor, 18: 24958 (NP-13907)
BARDADIN, M., SIUP geometrical reconstruction program, 18: 23887 (PAN-474/VI)
BARGOOT, F. John, Dosimetry for intracavitary Ra applicators, 18: 23395
BARINOVA, E. S., Chemical ripening of R emulsion, 18: 23497
BARINOVA, E. S., Possibility of nuclear emulsion having changing sensitivity, 18: 23923
BARINOVA, E. S., Structure and size of centers in R emulsion, 18: 23913
BARKAS, Walter H., Track measurements with digitized microscope, 18: 23940
BARKAS, Walter H., Video track analysis, 18: 23939
BARKER, P., Verification of direction of arrival of EAS, 18: 24344
BARKER, W. W., Non-stoichiometry in ternary rare-earth oxide systems, 18: 23509
BARNES, J. C., Spectrophotometric studies of electrolytic dissociation. VII., 18: 23501
BARNES, R. S., Gas bubble growth on heating irradiated U, 18: 24187 (AERE-R-2935)
BARNETT, M. Louise, Spectral evidence on rare-earth covalent binding, 18: 23438 (CONF-405-35)
BARRETT, N. T., Discussion on prestressed concrete pressure vessels, 18: 24825
BARROW, R. F., Spectrum of gaseous ScF, 18: 23531
BARSUKOV, V. S., Ploidy and radiosensitivity of yeast cells, 18: 23311
BARTH, Gunther, Therapy of lethal radiation injury with nicotinic acid derivatives. I., 18: 23365
BARTON, A. D., Soluble proteins from cell nuclei, 18: 23192 (ANL-6823 (p.124-7))
BARTON, James R., Prog. rpt. on earth resistance to projectile impact, 10/14/64–3/1/64, 18: 25001 (SC-DC-64-459)
BARUA, A. K., Repulsive energy between H and He atoms, 18: 24306
BARUT, A. O., Symmetry group containing both the Lorentz group and SU$_6$, 18: 24496
BAR'YAKHTAR, V. G., Kinetic equations for plasma electrons and photons radiated by them in strong magnetic field, 18: 24765 (JPRS-24633(p.43-61))
BARZDO, B. F., Penetrability of electrons through Al foils, 18: 24317
BASSEL, R. H., Elastic and inelastic scattering of C from C, 18: 24710
BASSEL, R. H., Pickup of heavy clusters, 18: 24714
BASTIDE, Pierre, Fructose activity in kidney after UO$_2$(NO$_3$)$_2$ intoxication, 18: 23213
BATCH, M. L., Reactor physics startup test of Indian Point reactor, 18: 24877 (BAW-189)
BATEMAN, A. J., Effects of x rays on female germ cells of *D. melanogaster*, 18: 23281
BATES, D. R., Recombination and energy balance in decaying plasma. I., 18: 24793
BATES, D. R., Recombination and energy balance in decaying plasma. II., 18: 24794
BATES, L. F., Magnetic susceptibility of some carbides of U and Th, 18: 24155
BATES, Roger G., Thermodynamics of DCl in D$_2$O, 18: 23484
BATZENSCHLAGER, A., Modifications in mice renal tubes treated with uranyl nitrate, 18: 23214
BAUER, R. W., Relative size of Ca-44 and Ca-40, 18: 24583 (CONF-502-4)
BAUMANN, H., Primary circulators for A.V.R. Brown Boveri-Krupp reactor, 18: 24912 (TID-7690(p.1-15))
BAUMANN, H., Primary circulators for O.E.C.D. high-temperature reactor project, 18: 24916 (TID-7690(p.189-206))
BAUN, William L., Infrared absorption study of metal oxides, 18: 23549
BAUTIN, A. V., Gyroscope motion in gravitation theories, 18: 24511
BAXTER, R. C., Retention of Sr-90 in rats, 18: 23243 (UR-642)
BAYSHTRUK, O. N., Regeneration of sciatic nerve in acute radiation sickness, 18: 23250 (JPRS-24704(p.12-17))
BAZAN, Fernando, Prog. rpt. on high-altitude balloon sampling, 4/24/64, 18: 23791 (NYO-10496(Add.))
BAZANOV, V. A., Accumulation of S^{35}-labeled mercamine in liver and spleen, 18: 23304
BEATTIE, J. R., Assessment of environmental hazard from fission-product releases, 18: 23816 (AHSB(S)R-64)
BEATTY, R. A., Gynogenesis in vertebrates, 18: 23335
BEAUMONT, Heather M., Radiosensitivity of male primordial germ cells and spermatogonia, 18: 23331
BEAUMONT, Heather M., Radiosensitivity of oogonia and oocytes at different stages, 18: 23340
BEAVER, R. J., Postirradiation evaluation of stainless steel-clad plate-type specimens, 18: 24195 (ORNL-TM-815)
BECKER, K., Bibliography on dosimetry, 18: 23807 (AED-C-21-01)
BECKER, K., Sources of error in neutron personal dose measurements, 18: 23961
BEDFORD, Joel S., Survival of HeLa cells exposed to protracted γ irradiation, 18: 23280
BEDNARZHOVA-NOVAKOVA, B., Sudden commencement of geomagnetic storms, 18: 24518
BEETS, C., Response of ionographic emulsions in analysis of fast neutrons, 18: 23960
BEG, Mirza A. Baqi, Peratization theory of Feinberg and Pais, 18: 24407
BEGLIOMINI, A., Inactivation of aphthous virus by radiation, 18: 23246 (AERE-Trans-1000)
BELCHIM, S. A., Prog. rpt. on water treatment and radioactive residues, 4–6/61, 18: 24979 (EURAEC-202)
BELL, J. S., Muon capture in heavy nuclei, 18: 24658
BELL, L. E., Particle disintegration study for re-entering NAP systems, 18: 24933 (AFSWC-TDR-63-51)
BELLONI, M. G., Rehomogenization kinetics of irradiation-segregated

Cu–Ni, 18: 24208

BELOUS, V. V., Effects of h-f electric field on glow discharge, 18: 24796

BELOV, K. P., Ferro- and antiferromagnetism of rare earths, 18: 24178

BELOV, S. V., Gamma-spectrometric method of analysis of I-131 and I-132, 18: 23432

BELYAKOV, V. A., Production of particles in nuclei, 18: 24587 (JINR-P-1584)

BELYAKOV, Yu. I., Application of omegatron for investigating structure of gases, 18: 24319

BEMENT, A. L., Effects of neutron irradiation on Zy-2, 18: 24191 (HW-SA-3194)

BEMENT, A. L., Effects of temperature and irradiation on austenitic stainless steels, 18: 24192 (HW-SA-3221)

BENAKIS, Achille, Synthesis of phenobarbital C-14, 18: 23568 (CEA-R-2406)

BENDICH, A., Amino acids as punctuation in genetic code of DNA, 18: 25011 (TID-20348)

BENEVOLENSKII, V. N., Radiation protection of phenoxazine derivatives, 18: 23378

BENNETT, J. R. J., Elastic scattering and reactions of Li ions, 18: 24325

BENOIT, H., Remote interactions within macromolecular chains, 18: 25034 (SC-T-64-902)

BENOIT, P., Fast transistorized electronic complex, 18: 24266

BENSON, G., Evidence that the f^0 has isotopic spin zero, 18: 24466

BERECH, John Jr., Role of age and x irradiation on mouse kidney function, 18: 23291

BEREZINA, O. N., Effect of preliminary x irradiation on susceptibility of white mice to ornithosis virus, 18: 23248 (JPRS-24696)

BERGE, J. P., Decay rate prediction for $2\Xi^-$, 18: 24446

BERKEY, F. T., Radio noise from auroral electrons. I., 18: 24537

BERKNER, Klaus H., Collisional electron detachment from 20-Mev D^0 and D^- ions, 18: 24310

BERLINER, David L., Effects of radiation on biosynthesis and biotransformation of corticosteroids, 18: 23348

BERLINER, Martha L., Effects of radiation on biosynthesis and biotransformation of corticosteroids, 18: 23348

BERMAN, P. A., Turbo-circulator for GCR-4 reactor system, 18: 24913 (TID-7690(p.16-75))

BERMOND, J., Determination of momentum of particles in emulsions, 18: 23945

BERNARD, M., Dose in vicinity of interface between two media exposed to x rays, 18: 23388

BERNETT, E. C., Examination of development-type thermionic power converters, 18: 24368 (JPL-TR-32-548)

BERNSTEIN, A. M., Relative size of Ca-44 and Ca-40, 18: 24583 (CONF-502-4)

BERRETH, J. R., Neutron cross section of Ta-182, 18: 24584 (IDO-16956)

BERRY, J. G., (He^3,n) reactions on various light nuclei, 18: 24650

BERRY, Ronald, Improvements in purification of He, 18: 23519

BERRY, W. B., Contact resistance of Fe-plated Pb telluride contact, 18: 24357 (ANL-6802(p.78-86))

BERTHOD, Louis, Liquid-pressure regulating devices, 18: 23867

BESSON, J., Hydrolysis of U carbides, 18: 23461 (ORNL-tr-122)

BETHENCOURT, A., Dose in vicinity of interface between two media exposed to x rays, 18: 23388

BETTENHAUSEN, L. H., Alpha-particle voltmeter, 18: 23846

BETZ, G., Neutron interaction cross sections on Si, 18: 24600 (NP-13930 (p.39-40))

BEVAN, D. J. M., Non-stoichiometry in ternary rare-earth oxide systems, 18: 23509

BEVINGTON, P. R., Precision accelerator voltage measurements, 18: 24242 (CONF-22-33)

BHATNAGAR, R. P., Cation-exchange resin for total anion analysis of solutions containing Be(II) ion, 18: 23423

BHATNAGAR, V. S., Radioactivity in cooling water in swimming pool reactor, 18: 24947 (AEET/AM/38)

BHATTACHARYYA, S. N., Coseparation of Th with Ca oxalate, 18: 23714

BHOWMIK, B., Lifetimes of charged Σ hyperons, 18: 24415

BIANCHI, G., Thermocouple irradiation tests, 18: 23840 (RT/ING(64)-2)

BICKERDIKE, Robert Lewis, Making impermeable composite carbon tube, 18: 24117

BIEBL, Richard, Radiation protection of plant cells. II., 18: 23374

BIEDENHARN, L. C., Symmetrization in coulomb excitation calculations, 18: 24731

BIEL, W., Cross section measurements on Pd for epithermal neutron energies, 18: 24609 (NP-13930(p.112-13))

BIENVENU, C., Survey of E.D.F. 4, 18: 24920

BIERIG, R. W., Trivalent rare-earth ions in CaF_2. I., 18: 23526

BIERIG, R. W., Trivalent rare-earth ions in CaF_2. II., 18: 23527

BILTZ, Wilhelm, Some fusible electrolytes, 18: 23456 (AI-Trans-46)

BINGHAM, C. D., ESADA fuel fabrication, 18: 23404 (AI-8700(Vol.V))

BINSCH, Gerhard, Nitrogen-15 magnetic resonance spectroscopy. I., 18: 23530

BIRECKA, Helena, Influence of x rays on higher plants, 18: 23253 (OTS-61-11326)

BISHARA, B. A., Lifetime measurements in Sb-121, 18: 24683

BISHOP, E. V., Perturbations in nuclear collective motion, 18: 24730

BISKIS, Birute O., Parameters of radiation dosage that influence osteogenic sarcomas, 18: 23231 (ANL-6823(p.20-43))

BISSELL, Eugene R., Isomers of chloroiodotrifluoroethane, 18: 25016 (UCRL-7373)

BISWAS, S., Rigidity spectra of solar cosmic rays, 18: 24326

BISWAS, S. N., Λ-Λ-Binding in light hypernuclei, 18: 24656

BLACK, Clanton C., Triphosphopyridine nucleotide reduction by spinach chloroplasts, 18: 23198 (ANL-6823(p.191-8))

BLAIR, A. G., Reaction (He^3,d) on $Ni^{58,60}$, 18: 24590 (LADC-6370)

BLAIR, A. G., 4^- State in Zr-90, 18: 24663

BLAIR, Henry A., Addition of modes of radiation injury in producing lethality, 18: 23245 (UR-654)

BLAIR, R. W., Welded-metal-bellows shutdown seals, 18: 24823 (TID-7690(p.176-88))

BLAISSE, B. S., Magnetic behavior and I-H curve of superconductors, 18: 24552

BLANC, D., Excitation and ionization in rare gases, 18: 23972

BLANCO, Angel Alberto, Manufacture of plastics-lined neutron shields, 18: 24809

BLAND, C. J., Measurement of atmospheric radioactivity in Chacaltaya, 18: 23803

BLAND, C. J., Transistorization of neutron monitor, 18: 23966

BLAND, W. F., Radiation monitoring, 18: 23901

BLINOV, B. V., Suprarenals in radiation sickness, 18: 23321

BLINOV, M. V., Angular and energy characteristics of fission-neutron emission of U-235, 18: 24697

BLOKHINTSEV, D. I., Acausality and dispersion relations, 18: 24383 (JINR-E-1646)

BLOMEKE, J. O., Management of fission-product H-3 in fuel processing wastes, 18: 24978 (ORNL-TM-851)

BOARDMAN, Charles R., Contained nuclear explosions for evaluation of mining applications, 18: 23751 (UCRL-7350)

BOBROV, M. S., Magnetic disturbances at conjugate points, 18: 24526

BOCHKAREV, V. N., Laboratory measuring-registering center, 18: 23881

BOCHKOVA, O. P., Observation of unstable regime during transition from weak to strong h-f discharge, 18: 24784

BOCQUET, H., Control of artificial atmospheric radioactivity, 18: 23799

BOEHM, H., Age-hardening, 18: 24154 (RSIC-174)

BOELLA, G., Analysis of tracks created in Pb-plate spark chamber, 18: 23973

BOETTINGER, W. L., Foil activation programs, 18: 23871 (ANL-6822)

BOGATOV, L. V., Radiation effects on bone marrow-blood formation, 18: 23305

BOGOMOLOV, C., Interaction between charged particles and electrons of AgBr in emulsions, 18: 23908

BOGOMOLOV, K. S., Emulsions for nuclear research, type-M NIKFI, 18: 23917

BOGOMOLOV, K. S., Moisture influence on the stability of emulsions, 18: 23922

BOLLINGER, L. M., Total neutron cross section of Mn, 18: 24678

BOLOTIN, Yu. L., Interaction between charged particles and non-equilibrium plasma, 18: 24802

BOLTON, H. C., Kronig-Kramers relations in nuclear magnetic resonance, 18: 24659

BOLYUNOVA, A. D., Geophysical investigations by means of Cosmos 3 and 5, 18: 24328

BOLYUNOVA, A. D., Some characteristics of geoactive particles,

18: 24327
BOMPIANI, C., Distribution of Na thiocyanate for tumor bearers exposed to irradiation. I., 18: 23285
BONES, R. J., Oxygen/metal ratios for U, Pu and (U,Pu) oxides, 18: 23403 (AERE-R-4608)
BONNET, Georges, Enhanced polarization nuclear-free precission magnetometer, 18: 23869
BOOTH, Rex, Ferromagnetism in dilute solutions of Fe in Au, 18: 24143 (UCRL-7390)
BORDNER, Linda F., Effect of x radiation on oxidative phosphorylation in liver mitochondria, 18: 23233 (ANL-6823(p.157-60))
BORENFREUND, E., Amino acids as punctuation in genetic code of DNA, 18: 25011 (TID-20348)
BORG, R. J., Ferromagnetism in dilute solutions of Fe in Au, 18: 24143 (UCRL-7390)
BORGERS, M., Cells of duodenum of mouse after x irradiation, 18: 23266
BORGGREEN, J., Reaction $C^{12}(C^{12},\alpha)Ne^{20}$, 18: 24724
BORGIA, B., Polarization of Λ^0 from $\gamma + p = K^+ + \Lambda^0$, 18: 24428
BORISHEVICH, V. A., Structural changes and physical properties of reactor IRT-2000, 18: 24960 (NP-13911)
BORISOVSKII, E. S., Preparation of Zr, 18: 24110
BORMANN, M., Cross sections of nuclear reactions caused by neutrons, 18: 24601 (NP-13930(p.41-2))
BORMANN, M., Energy dependence of neutron cross sections, 18: 24602 (NP-13930(p.43-9))
BORN, H. J., Activation determination of Li, 18: 23427
BORN, H. J., Determination of O-18 concentration in water, 18: 23426
BORNSTEIN, Ira, Thermal reactor, 18: 24853
BOSGRA, S. J., Measurements on short-range hyperfragments, 18: 24445
BOUCHERIE, A., Transistorized buffer memory, 18: 23854
BOUSQUET, C., Point-by-point study of surface of crystal, 18: 25035 (UCRL-Trans-1055(L))
BOUTIN, Henri, Crystal structure of ferroelectric Li hydrazinium sulfate, 18: 24989 (BNL-7034)
BOVET, Claude, Very thin plates having central supports, 18: 23925
BOWEN, H. J. M., Determination of Ca and Mg in biological material by radioactivation analysis, 18: 23418
BOWEN, H. J. M., Effects of ionizing radiation on soils, 18: 23318
BOWEN, J. H., Protection of boiling water reactors, 18: 24924
BOWMAN, Melvin G., High-temperature chemistry of refractory carbides, 18: 24133 (LADC-6391)
BOYADZHIEV, A. V., Production of particles in nuclei, 18: 24587 (JINR-P-1584)
BRADLEY, Norman, Nuclear power plant for superheated steam, 18: 24931
BRAGIN, M. L., Some characteristics of geoactive particles, 18: 24327
BRANDON, C. A., MSRE capsule irradiation experiment, 18: 24907 (ORNL-TM-870)
BRANDSHTETR, I., Chromatographic separation of rare earths, 18: 23722
BRANDSHTETR, I., Reactions of heavy elements with multicharged ions. II., 18: 24689
BRANDSHTETR, I., Yield of fission fragments from heavy nucleus fission. I., 18: 24690
BRANDSHTETTR, I., Extraction properties of Fm and Md, 18: 23725
BRANDT, N. B., Effect of high pressure on superconducting properties of Zr, 18: 24560
BRANSDEN, B. H., Existence of solutions of partial-wave dispersion relations, 18: 24425
BRAUN, H., Mechanisms of hypersensitization of ionographic emulsions, 18: 23550
BRAUN, H., Results at Strasbourg in stripping, etc., for high-energy studies, 18: 23941
BRAYER, R. C., Prog. rpt. on stress-corrosion cracking of stainless steels, 1-3/64, 18: 24125 (CEND-3256-209)
BRECHER, Charles, Stimulated emission processes in rare earth chelates, 18: 24229
BREIT, G., Analysis of nucleon transfer data, 18: 24618 (NYO-1807-8)
BREIT, G., Limited applicability of nucleon tunneling theory, 18: 24617 (NYO-1807-7)
BREYER, Evelyn P., Intranuclear stratification in amoeba, 18: 23197 (ANL-6823(p.169-73))
BREZHNEVA, N. E., Isolation of carrier-free radioactive Ce from fission products, 18: 23727
BRIDGE, H., Plasma measurements on IPM-A, 18: 24749 (CONF-521-2)
BRIGGS, R. W., Power generation and conditioning for SNAP, 18: 24942
BRILL, O. D., Search for light neutron nuclei, 18: 24616 (NP-13964)
BRINDA, S., Nuclear emulsion plate "shuffler", 18: 23847
BROCKETT, G. F., SPERT transient pressure measurements, 18: 24954 (IDO-16930)
BROMLEY, D. A., Boron-induced transfer reaction studies, 18: 24715
BROMLEY, D. A., Dissociation reactions in light nuclei, 18: 24723
BROMLEY, D. A., Perturbations in nuclear collective motion, 18: 24730
BROOKE, G., Energy spectrum of cosmic-ray pions, 18: 24341
BROOKE, G., Momentum spectrum of cosmic-ray protons, 18: 24339
BROOKE, G., Primary and sea-level spectra of cosmic rays, 18: 24340
BROOKS, G., Antimatter in the cosmic radiation, 18: 24335
BROOKSBANK, R. E., Recovery of Pu from irradiated Pu–Al alloy, 18: 23702 (ORNL-3566)
BROOKSBY, Gerald, X-irradiation effects on reproductive function in female hamster, 18: 23344
BROU, R., Determination of momentum of particles in emulsions, 18: 23945
BROWN, Anthony Reginald George, Making impermeable composite carbon tube, 18: 24117
BROWN, G. E., Theory of nuclear matter, 18: 24593 (NP-13925)
BROWN, Lawrence E., Linear particle accelerator, 18: 24268
BROWN, S. O., Effects of continuous pre- and postnatal irradiation on reproduction in the albino rat, 18: 23343
BROWN, Sidney O., Effect of continuous radiation on reproductive capacity and fertility, 18: 23328
BROWNING, William E., Jr., Removal of radioiodine vapor from gases, 18: 23386 (CONF-12-3)
BRUCE, A. K., Extraction of radioresistant factor of *Micrococcus radiodurans*, 18: 23222
BRUDERMUELLER, G., Karlsruhe Van de Graaff project for fast neutrons, 18: 24246 (NP-13930(p.137-8))
BRUES, Austin M., Dose to gonads from injected Sr-90 and Y-90, 18: 23185 (ANL-6823(p.76-80))
BRUES, Austin M., Effects of Pu injected subcutaneously in rat, 18: 23232 (ANL-6823(p.81-5))
BRUNER, Buddy L., Gaseous equilibrium between Cd and $CdCl_2$, 18: 23483
BRUNNEE, C., Quadrupole h-f mass spectrometer for vacuum applications, 18: 23433
BRUSSAARD, P. J., Symmetrization in coulomb excitation calculations, 18: 24731
BRYAN, Gary W., Plastid development and chlorophyll production in Chlorella mutant C-10, 18: 23196 (ANL-6823(p.161-4))
BRYANT, H. C., (He^3,n) reactions on various light nuclei, 18: 24650
BRYDEN, A. D., Foldy-Wouthuysen transformation for particles of spin 3/2, 18: 24493
BUCCI, N. W., Power generation and conditioning for SNAP, 18: 24942
BUCCINO, S. G., Precision accelerator voltage measurements, 18: 24242 (CONF-22-33)
BUCHEL'NIKOVA, N. S., Universal instability in K plasma, 18: 24803
BUCHSBAUM, S. J., Light-off-light scattering in a plasma, 18: 24788
BUCKINGHAM, R. A., Interaction of H and He atoms, 18: 24313
BUETTNER, H., New work on level densities, 18: 24596 (NP-13930(p.14))
BUKATA, Stanley, Ion exchange in concentrated electrolyte solutions. III., 18: 23480
BULEY, E. R., System of N atoms interacting with radiation field, 18: 24309
BULGAKOVA, V. G., Influence of inactivation on protective properties of antibiotics, 18: 23380
BUNDSCHUH, G., Inelastic scattering cross sections on Na-23 to 4 Mev, 18: 24597 (NP-13930(p.15))
BURBIDGE, E. Margaret, Relativistic astrophysics, 18: 24277
BURBIDGE, G. R., Relativistic astrophysics, 18: 24277
BURDET, A., Penetration of U into emulsions, 18: 23553
BURDG, C. E., Prog. rpt. on UO_2 fuel systems, 4/64, 18: 24854 (CEND-2863-211)
BURIKS, Peter, High-energy injection of particles in mirror machine, 18: 24767 (KFK-tr-141)
BURLEFINGER, E., Action of ion beams on nuclear emulsions, 18: 23916
BURLEIGH, Richard J., Facilities and activity on 184-in. cyclotron, 18: 24249 (UCRL-11316)

BURNETT, Donald S., Fission barrier of Tl-201, 18: 24670
BURNETT, John L., Heats of formation of $Eu^{+3}(aq)$, $Eu^{+2}(aq)$, and EuO[illegible] 18: 23453 (UCRL-11126)
BURNETT, L. L., Radiation cataract in clinical therapeutic radiology, 18: 23313
BURNHAM, Marvin W., Prog. rpt. on explosive parameters for MHD energy conversion, final, 6/24/60–7/24/63, 18: 24365 (ASD-TDR-63-37)
BURNSTEIN, R. A., Charged sigma hyperon leptonic decays, 18: 24402 (TID-19033)
BUSTAD, L. K., Metabolism of SNAP radionuclides in swine, 18: 23200 (HW-SA-3350)
BUTLER, D., Gamma ionization in plasma diode, 18: 24373
BUTLER, S. T., Creation of deuterons from high-energy proton bombardment of matter, 18: 24664
BUTLER, S. T., Production of highly excited neutral atoms for injection into plasma devices. I., 18: 24757 (NP-13948)
BUTSLOV, M. M., Isotropic discharge chamber for detecting tracks of relativistic charged particles, 18: 23874 (JINR-P-1619)
BUTTLE, P. J. A., Finite range effects in deuteron stripping processes, 18: 24686
BUTTREY, John W., Photovoltaic energy conversion and fuel cell, 18: 24356 (ANL-6802(p.64-5))
BUZZARD, R. J., Prog. rpt. on thermionic converter for nuclear applications, 10/9/62–9/30/63, 18: 24369 (NP-13892)
BYCHENKOV, V. S., Characteristics of nuclear emulsions loaded with W, 18: 23920

C

CABIBBO, N., Determination of form factors in $K_{\mu 3}$ decays, 18: 24447
CABLE, J. W., Antiferromagnetism of Pr, 18: 24172
CABLE, J. W., Magnetic structures of rare earth Mn oxides, 18: 23523
CABLE, J. W., Magnetic structures of rare earth manganites ($RMnO_3$), 18: 24128 (CONF-405-34)
CACCIANI, A., Analysis of excitation curves in photoproduction, 18: 24381 (ISS-64/4)
CADWELL, W. R., WIGLE program for solution of two-group space-time diffusion equations in slab geometry, 18: 24572 (WAPD-TM-416)
CAINI, V., Fast-slow coincidence matrix system, 18: 23844
CALETKA, Rostislav, Chemistry of water solutions of Zr, 18: 23472
CAMBEL, A. B., Properties of gases at high temperatures, 18: 24742 (ANL-6802(p.15-18))
CAMPAIGNE, E., 3-Alkyl-1,3-thiazane derivatives and precursors, 18: 23370
CAMPBELL, Herbert, Damage assessment and data base on shelter needs, 18: 23826 (NP-13942)
CAMPBELL, Ronald Hugh, Determination of flux in core of a reactor, 18: 24840
CAMPBELL, Ronald Hugh, Monitoring gas-cooled nuclear reactors, 18: 24839
CAMPSIE, Ian Cochran, Fabrication of reactor fuel elements, 18: 24116
CANTWELL, R. M., Monte Carlo calculations of reactor eigenvalues, 18: 24818 (WAPD-T-1649)
CAO-XUAN-CHUAN, Reaction (n,α) on N, 18: 24643
CARDEN, Wallace F., Determination of Ni in Th metal, 18: 23414 (Y-1464)
CARDINAL, C., Ionographic study of fission of Th-232 by 15.3-Mev neutrons, 18: 23959
CARLSEN, Frank S., Table of $\sin^2\theta$ vs. θ and 2θ, 18: 24990 (IS-842)
CARLSON, R. R., Two-parameter analysis of Li reactions, 18: 24722
CARLSON, W. D., Effect of testicular x irradiation on bull semen, 18: 23337
CARLSON, William D., Effects of ionizing radiation on reproductive system, 18: 23175
CARLSTEIN, R. G., Island-cell tumors in irradiated rats in parabiosis, 18: 23286
CARNICERO, I., Radiochemical purity of solutions of phosphates and pyrophosphates, 18: 23417
CAROLI, C., Vortex line in type-II superconductor, 18: 24551
CARREAU, G., Ionographic study of fission of Th-232 by 15.3-Mev neutrons, 18: 23959
CARRUTHERS, R., Engineering with superconductors, 18: 24546
CARSTEN, Arland L., Hematological effects of x irradiation in the rat, 18: 23296
CARTER, D. H., Buckling and reaction rates in Pu–graphite assemblies, 18: 24852
CARTER, Forrest L., Valence bond considerations in Th_3P_4 structure, 18: 23508
CARTER, R. L., Acoustically resonant Stirling engine, 18: 24364 (ANL-6802(p.166-9))
CARVALHO, H. G., Protective effects of Na sulfite on amidol developer, 18: 23554
CASANOVA, J., Distortion of plates swollen with colophony rosin, 18: 23556
CASARETT, G. W., Gross developmental anomalies induced by Sr-90 in rat embryo, 18: 23244 (UR-643)
CASARETT, G. W., Retention of Sr-90 in rats, 18: 23243 (UR-642)
CASERTA, G., Monitor for exposure dose intensity, 18: 23889 (RT/EL(64)-1)
CASTLE, Richard T., Circular polarization measurements in Eu-154, 18: 24668
CATALA, J., Distortion of plates swollen with colophony rosin, 18: 23556
CATTANACH, Bruce M., Genetical approach to effects of radiomimetic chemicals on fertility in mice, 18: 23177
CAWSE, P. A., Determination of Ca and Mg in biological material by radioactivation analysis, 18: 23418
CAWSE, P. A., Effects of ionizing radiation on soils, 18: 23318
CELNIK, J., Minimum-weight proton shields, 18: 24805 (UNC-5049)
CERESARA, S., Pre-precipitation rate in Al–Zn alloy, 18: 24206
CERMAK, Jan, Monochromatization of x rays, 18: 24224
CESARANO, C., Rapid separation of Np-239 and Pa-233, 18: 23409 (RT/CHI(63)-31)
CHABOSEAU, Jacques P., Construction and operation of gas-bearing compressors, 18: 23744 (TID-7690(p.219-35))
CHABOSEAU, Jacques P., Multi-pad gas bearings, 18: 23746 (TID-7690 (p.263-72))
CHALFANT, A. I., Technology for the SNAP-50/SPUR powerplant, 18: 24945
CHAMPLIN, J. N., Program for prediction of hydrodynamic flow oscillations, 18: 23767 (KAPL-M-6149)
CHAN, C. H., High-energy lepton-nucleon scattering, 18: 24419
CHANDLEY, Ann C., Effects of x rays on female germ cells of *D. melanogaster*, 18: 23281
CHANDRA, S., Plasma diffusion in the ionosphere, 18: 24781
CHANG, M. C., Effects of irradiation on metabolism of spermatozoa, 18: 23297
CHANG, M. C., Effects of ionizing irradiation of gametes and zygotes on embryonic development, 18: 23327
CHANG, T. S., Radiation genetics of Rhesus monkey, *Macaca mulatta*. I., 18: 23317
CHANG, Tsing-lien, Thermal expansion of O-18 H_2O, 18: 23546
CHANG-KUANG, Separation and determination of Zr and Th, 18: 23416 (JPRS-24593(p.10-12))
CHANTEUR, J., Localization of consecutive activated zones after exposure to high neutron flux, 18: 23890 (SCPRI(S)-92)
CHAO, Too-nan, Separation of Au from chloride solutions, 18: 23718
CHAPELOT, A., Data processing in the control of nuclear reactors, 18: 24828
CHAPIN, D. S., Phase transition region of $PrO_{1.8}$, 18: 23504
CHARAKHCH'YAN, A. N., Secular variation of cosmic-ray intensity, 18: 24331
CHARAKHCH'YAN, T. N., Secular variation of cosmic-ray intensity, 18: 24331
CHASE, R. L., Data processing, 18: 23849
CHASMAN, C., Boron-induced transfer reaction studies, 18: 24715
CHASMAN, C., Dissociation reactions in light nuclei, 18: 24723
CHATEAU, D., Effect of localized x rays on bone marrow, 18: 23265
CHATTERJEE, S., Repulsive energy between H and He atoms, 18: 24306
CHAUDRON, G., Structural properties of stainless steels, 18: 24151 (EURAEC-986)
CHAUVIN, G., Production of UO_2 crystals, 18: 23458 (HW-tr-71)
CHEN, C. W., Magnetic moments and unpaired spin densities in Fe–Rh, 18: 24169
CHERNILIN, Yu. F., Yield of Na-24 from Al in H_2O during irradiation of Al,

18: 24592 (NP-13913)
CHERNOCK, W. P., Prog. rpt. on UO$_2$ fuel systems, 4/64, 18: 24854 (CEND-2863-211)
CHERNOCK, W. P., Prog. rpt. on stress-corrosion cracking of stainless steels, 1–3/64, 18: 24125 (CEND-3256-209)
CHERNYSHOV, A. A., Thermalizing properties of water and certain organic compounds, 18: 24566 (NP-13912)
CHERRY, R. D., Alpha-activity at 4.4 Mev in natural Th, 18: 23802
CHEVALLIER, Andre, Effect of localized x rays on bone marrow, 18: 23265
CHHABRA, A. S., Improved whole-body counting geometry, 18: 23394
CHIAPETTA, R. L., Prog. rpt. on reactor containment, 2–4/64, 18: 24824 (TID-20613)
CHIKOVANI, G. E., Mechanism of operation of track spark chambers, 18: 23968
CHIU, S. F., Radiation genetics of Rhesus monkey, *Macaca mulatta*. I., 18: 23317
CHLEBOWSKA, D., Fractional parentage coefficients $\langle p^n/p^{n-1}, p^1\rangle$, 18: 24621 (PAN-449/VII)
CHOW, J. G. Y., Effect of twinning on yield stress of polycrystalline Fe, 18: 24129 (CONF-524-5)
CHRIST, J., Scattering of subthermal neutrons on lattice defects, 18: 24194 (NP-13930(p.116-17))
CHRISTOPHOROU, L. G., Capture of low-energy electrons in chlorobenzene and bromobenzene, 18: 23686
CHUAN, Ning-sen, Preparation of single crystals of CaF$_2$, 18: 23460 (JPRS-24593(p.98-101))
CHUBURKOV, Yu. T., Preparation of Th, U, and Pu oxide and rare earth coatings, 18: 23537
CHUDINOVSKIKH, A. V., Comparisons of albumen and α_1 globulin sera isolated before and after irradiation, 18: 23306
CHUKIN, V. S., Controlled exposure of nuclear emulsions on sputniks, 18: 23957
CHUN, Me, Investigations of γ-quanta, produced in interactions of π^--mesons with nucleons and nuclei at $\approx$7 Bev, 18: 24391 (JINR-P-1629)
CHUN, Me, Properties of π^0 mesons produced in π^--N and π^--C interactions, 18: 24390 (JINR-P-1624)
CHUTE, R. N., Island-cell tumors in irradiated rats in parabiosis, 18: 23286
CHWASZCZEWSKA, Janina, Silicon surface-barrier detector, 18: 23962
CHWASZCZEWSKI, Stefan, Propriety of plasmoids created in a coaxial plasma gun, 18: 24782
CIRELLI, R., Pion-nucleon coupling constant, 18: 24423
CLANCY, E. F., Zero power experiments for SM-1 Core III, 18: 24873 (ACNP-64517(Rev.1))
CLARK, Evelyn, Species comparisons of radiation response of gonads, 18: 23323
CLARK, G., Properties of EAS at 4200 meters, 18: 24343
CLARK, G. W., Existence of extensive showers of primary γ radiation, 18: 24342
CLARK, W. E., Removal of Hg from radioactive waste solutions, 18: 24977 (ORNL-TM-827)
CLARK, Willie E., Index to conferences relating to nuclear science, 18: 25005 (TID-4043(Rev.1))
CLARKE, E. M., Cross sections for ion-molecule reaction $H_3^{+*} + H_2 \rightarrow H_3^+ + H$, 18: 24312
CLARKE, W. G., Buckling and reaction rates in Pu–graphite assemblies, 18: 24852
CLAUDSON, T. T., Irradiation effects on high-temperature reactor structural metals, 18: 24193 (HW-SA-3436)
CLAUS, Jacques, Precipitation of uranium oxide, 18: 23436 (CEA-R-2414)
CLAY, A., Intravenous injections of Guerin epithelioma. VI., 18: 23264
CLAYTON, A. J., Program PIP1 for solution of multigroup equations of method of collision probabilities, 18: 24378 (AEEW-R-326)
CLAYTON, C. G., Use of pump to reduce mixing length in dilution method of flow measurement, 18: 23762 (AERE-R-4623)
CLERMONT, Yves, Rate of spermatogenesis in man, 18: 23176
CLIFFORD, A. F., Nature of the chemisorbed acetate on PrO$_2$, 18: 23514
CLINE, J. E., Prog. rpt. on gamma spectrometry, annual, 3/27/64, 18: 24585 (IDO-16969)
COCHI, C., Monitor for exposure dose intensity, 18: 23889 (RT/EL(64)-1)
COCHRAN, J. Denny, Initial operation of Hallam power facility, 18: 24878 (CONF-504-3)
COHEN, A. D., Enhanced double quantum signals in nuclear magnetic resonance, 18: 24644
COLE, Arthur, Electron microscopic studies of isolated mammalian chromosomes, 18: 25008 (TID-19032)
COLE, J. K., Error analysis of two-component strain-gage balance, 18: 25002 (SC-TM-64-8)
COLLE, P., Response of ionographic emulsions in analysis of fast neutrons, 18: 23960
COLLINGS, E. W., Role of s-d exchange interactions in dilute alloys, 18: 24555
COLLINS, C. G., Organic, structural and control materials, 18: 24937 (APEX-917)
COLLOT, Claude, Transformation of U–Nb alloys, 18: 24124 (CEA-2341)
COLMAN, David M., Titration of boric acid in aqueous solution, 18: 23412 (UCRL-7756)
COLOMBO, R. L., Influence of local variations in O/U ratio during UO$_2$ pellet sintering, 18: 24109
COLTON, R., Preparation of Mo oxidetetrachloride, 18: 23465
COLVIN, R. V., Thermal conductivity of Sc between 5 and 320°K, 18: 24182
CONDO, G. T., Absorption of π^- in light nuclei, 18: 24582 (AD-439331)
CONLIN, J. A., MSRE capsule irradiation experiment, 18: 24907 (ORNL-TM-870)
CONTI, M., Ispra-2—description and safety, 18: 24962 (RT/ING(63)-25)
Contreras, Ma. de los Angeles
see de los Angeles Contreras, Ma.
CONWAY, J. B., BeO phase transformation, 18: 24163
CONZETT, H. E., Conference on reactions between complex nuclei, 3rd, Asilomar, California, 4/63, 18: 24707
COOK, J. E., Experience with beams from reactors, 18: 23813 (AERE-R-4528(p.49-53))
COOK, J. E., Experience in fuel element cropping and irradiation ponds, 18: 23814 (AERE-R-4528(p.55-67))
COOK, J. E., Health physics control of research reactors, 18: 23809 (AERE-R-4528)
COOPER, J., Emission-line profile measurements in transient plasmas, 18: 24791
CORBETT, John D., Gaseous equilibrium between Cd and CdCl$_2$, 18: 23483
CORIOU, H., Production of UO$_2$ crystals, 18: 23458 (HW-tr-71)
CORNELL, Anthony, Some fusible electrolytes, 18: 23456 (AI-Trans-46)
CORTELLESSA, G., Analysis of excitation curves in photoproduction, 18: 24381 (ISS-64/4)
CORTELLESSA, G., Use of internal beam of synchrotron for study of reaction (e,e′ p), 18: 24243 (ISS-63/42)
CORTINI, G., Photofission of Bi, W, and Ag, 18: 24655
COSACK, M., Reaction (d,n) on Be-9, B-10, B-11, Si-28, and P-31, 18: 24611 (NP-13930(p.132-3))
COSACK, M., Time-of-flight spectrometer for fast neutrons, 18: 23882 (NP-13930(p.144-6))
COSTANTINO, C. J., Prog. rpt. on reactor containment, 2–4/64, 18: 24824 (TID-20613)
COTE, R. E., Total neutron cross section of Mn, 18: 24678
COTTINI, C., Converter for pulse analysis, 18: 23851
COTTRELL, D. M., Detection of low-intensity radiations with nuclear emulsions, 18: 23921
COTZIAS, George C., Trace metals: essential or detrimental to life, 18: 23199 (BNL-828)
COURANT, H., Charged sigma hyperon leptonic decays, 18: 24402 (TID-19033)
COUROT, M., Irradiation with x rays of testes of lambs, 18: 23338
COX, Thomas, PM advanced core designs, 18: 24899 (NP-13900(Sect.4))
CRAMER, J. G., Jr., Integrated computer-analyzer system, 18: 23860
CRANE, J., Prog. rpt. on fuel cycle development, 10/62–6/63, 18: 24860 (UNC-5071)
CREASY, Min, Oxygen-dependent postirradiation restoration of *Rhizopus stolonifer* sporangiospores, 18: 23288
CROMER, Alan H., Quasifree proton-deuteron scattering corrections, 18: 24450
CROOKS, J., Effects of x irradiation on rat thyroid gland, 18: 23260
CROUTHAMEL, C. E., Hydride and bimetallic regenerative EMF cells, 18: 24355 (ANL-6802(p.53-63))
CROWTHER, Peter, Absolute determination of I-125, 18: 23390

CUEER, P., Mechanisms of hypersensitization of ionographic emulsions, 18: 23550
CUEER, P., Particle photography in high energies, 18: 23905
CULICK, Fred E. C., Compressible MGD channel flow, 18: 23777
CUMMINGS, F. W., System of N atoms interacting with radiation field, 18: 24309
CUNNINGHAM, B. B., Heats of formation of Eu^{++}(aq), Eu^{+3}(aq), and $EuO_{1.483}$ 18: 23453 (UCRL-11126)
CUNNINGHAM, W. J., Application of time-lag models to natural populations, 18: 25012 (TID-20579)
CURRY, N. A., Crystallographic study of solid benzene, 18: 23575
CURTIS, Howard J., Biology of aging, 18: 23165 (BNL-854)
CURTIS, Howard J., Role of age and x irradiation on mouse kidney function, 18: 23291
CURTIS, W. K., Portable shower cabinet, 18: 23808 (AERE-R-4084)
CURTIS, W. K., Shielding and sealing master-slave No. 7 manipulator, 18: 23753 (AERE-R-4085)
CURZON, A. E., Electron-diffraction patterns from solid D, 18: 24558
CUSSAC, Y., Modifications in mice renal tubes treated with uranyl nitrate, 18: 23214
CZAJKA, D. M., Potentiation of chemotherapy of tumors by D_2O, 18: 23209
CZAPSKI, Gideon, Transient spectra and rate constants in oxygenated aqueous solutions, 18: 23678

D

DAANE, A. H., Decomposition pressure of Ho carbides, 18: 23440 (CONF-405-38)
DAANE, A. H., High-temperature allotropy of heavy rare-earth metals, 18: 24176
DABROWSKI, Andrzej, Silicon surface-barrier detector, 18: 23962
DAGLISH, M., Determination of Ca and Mg in biological material by radioactivation analysis, 18: 23418
DAHL-JENSEN, E., Spurious scattering investigations, 18: 23934
DAKHNO, L. G., Nature of low-energy interaction of π mesons, 18: 24474
DAKHNO, L. G., Three-particle production near threshold when two particles interact resonantly, 18: 24479
DAKOWSKI, Miroslaw, Silicon surface-barrier detector, 18: 23962
DALCHER, A. W., Design of the SNAP-10A reactor, 18: 24944
DALY, Richard, Quake at Bodega, 18: 23832
DAMANI, V. D., Orthophosphate of Th, 18: 23478
D'AMATO, F., Radiation mutations in durum wheat, 18: 23320
DAMEWOOD, Logan A., Effects of chronic and LD_{50} x-ray doses on reproductive potential of sheep, 18: 23342
DAMJANOVICH, S., Effect of x rays on ATPase activity of myosin, 18: 23258
DAMLE, P. S., Λ-Λ-Binding in light hypernuclei, 18: 24656
DANIELS, Edward W., Heavy metal compounds as fixatives for electron microscopy, 18: 23162 (ANL-6823(p.174-7))
DANIELS, Edward W., Intranuclear stratification in amoeba, 18: 23197 (ANL-6823(p.169-73))
DANIELS, Edward W., Isolation cell components from *Amoeba proteus*, 18: 23191(ANL-6823(p.118-23))
DANILOV, L. T., Processes and reaction products of high-molecular-weight compounds with inorganic salts. III., 18: 23542
DANILOV, V. N., Neutralization of ion beam with electrons in magnetic field, 18: 24301 (FTD-TT-64-176)
D'ANNESSA, A. T., Solid-state bonding of refractory metals, 18: 24112
DARDEN, S. E., Tensor polarization of deuterons scattered from He-4, 18: 24647
DARRIULAT, P., Scattering of 65-Mev He ions from O-16, 18: 24623 (UCRL-10727)
DAS, Gobinda, Influence of quenching conditions on vacancy loops in Al, 18: 24144 (UCRL-11188)
DASHEN, R. F., Unitary symmetry and photoproduction of η mesons, 18: 24438
DA SILVA, A. G., Nuclear emulsion techniques for fission studies, 18: 23958
DASTUGUE, Gaston, Fructose activity in kidney after $UO_2(NO_3)_2$ intoxication, 18: 23213
DAVIES, K. T. R., Scattering from polarized nuclei, 18: 24645
DAVIS, D. H., Loading of emulsion stacks with aqueous solutions, 18: 23919
DAVIS, Donald R., Heavy hydrocarbons from solid methane by ionizing radiation, 18: 23697
DAVIS, R. H., Complex nucleus aspects of α-particle scattering, 18: 24712
DAVISON, William Henry Thomas, Coating surface with irradiated polymerizable material, 18: 23400
DAY, R. B., 4^- State in Zr-90, 18: 24663
DAYTON, Russell W., Prog. rpt. on civilian applications, 2/64, 18: 24983 (BMI-1665(Del.))
DEARBORN, K., Electron microscopy of β beryllia, 18: 23563
DEARNALEY, G., Semiconductor counters for nuclear radiations, 18: 23969
DEBEAUVAIS-WACK, M., Mechanisms of hypersensitization of ionographic emulsions, 18: 23550
DEBEAUVAIS-WACK, M., Utilization of low temperature for discrimination between particles, 18: 23911
DEBERDEEV, M. Y., Emulsions for nuclear research, type-M NIKFI, 18: 23917
DE BOER, J., Effects of chronic whole-body irradiation on reproduction of C57 black mice, 18: 23326
DE BOER, J., Effects of chronic and LD_{50} x-ray doses on reproductive potential of sheep, 18: 23342
DE BOER, J., Excitation functions for coulomb excitation of 2+ and 4+ rotational levels in Sm-152, 18: 24727
DE BOER, Jelle, Effect of continuous radiation on reproductive capacity and fertility, 18: 23328
DE CARVALHO, H. G., Discrimination of low-energy protons in γ background, 18: 23929
DE CARVALHO, H. G., Nuclear emulsion techniques for fission studies, 18: 23958
DE CARVALHO, H. G., Photofission of Bi, W, and Ag, 18: 24655
DECK, R. T., High-frequency limit of bremsstrahlung spectrum, 18: 24426
DECKERS, H., Response of ionographic emulsions in analysis of fast neutrons, 18: 23960
DEDDENS, J. C., Reactor physics startup test of Indian Point reactor, 18: 24877 (BAW-189)
de Dominguez, Wilma Gonzales
  see Gonzales de Dominguez, Wilma
DEDYU, V. I., Verification of dispersion relations in small-angle- and high-energy region,. 18: 24386 (JINR-P-1598)
DE GENNES, P. G., Vortex line in type-II superconductor, 18: 24551
DEGLI-ANTONI, G., Analysis of tracks created in Pb-plate spark chamber, 18: 23973
DE JONG, L. N. J., Magnetic behavior and I-H curve of superconductors, 18: 24552
DE KERVENOAEL, O., Siloe super swimming pool reactor, 18: 24965
DELAPLACE, J., Resistivity measurements using d-c induction method, 18: 23837 (CEA-R-2402)
DELESSERT, R., Distortion and spurious scattering, 18: 23951
DELESSERT, R., Influence of development factors on parasitic scattering, 18: 23935
DEL GIUDICE, E., Photofission of Bi, W, and Ag, 18: 24655
DELGMANN, L., Quadrupole h-f mass spectrometer for vacuum applications, 18: 23433
DELLA CORTE, M., Photometric discrimination between protons and deuterons in emulsions, 18: 23943
DE LOS ANGELES CONTRERAS, Ma., Determination of total I in I-131-iodide preparations, 18: 23413 (UR-644)
DELSON, E. B., Navy seaplane power plant. IV., 18: 24935 (APEX-260)
DEL VAL COB, M., Radiochemical purity of solutions of phosphates and pyrophosphates, 18: 23417
DE MAEYER, L., Kinetic behavior of protons and deuterons in ice crystals, 18: 23466
DEMERS, J., Centrifugation for ionographic gelatine, 18: 23496
DEMERS, P., Centrifugation for ionographic gelatine, 18: 23496
DEMERS, S., Ionographic study of reactions of neutrons on C, 18: 24642
DEMIDOV, A. M., Research in nuclear and solid-state physics with research reactor IRT, 18: 24959 (NP-13910)
DEMIDOV, V. S., Absorption of slowed-down π^- mesons in propane, 18: 24475
DEMIRKHANOV, R. A., Skin effect in high-frequency ring discharge, 18: 24800
DEMMITT, T. F., Water quality monitoring system for NPR, 18: 24932

(HW-SA-3018)
DEMOULIN, R., Mechanisms of hypersensitization of ionographic emulsions, 18: 23550
DEM'YANOVA, T. A., Hydrogen bond in alkyl amine salts. I., 18: 23576
DENDY, P. P., Role of radiation in cell biology, 18: 23316
DE ROCHE, Georgia, Dose to gonads from injected Sr-90 and Y-90, 18: 23185 (ANL-6823(p.76-80))
DE ROCHE, Georgia, Effects of Pu injected subcutaneously in rat, 18: 23232 (ANL-6823(p.81-5))
DESHPANDE, V. V., Orthophosphate of Th, 18: 23478
DESPRETS, A., Response of ionographic emulsions in analysis of fast neutrons, 18: 23960
DESPREZ, S., Granulation curves from sensitivity of ionographic emulsion, 18: 23909
DE SY, A. L., Electrolytical polishing application in metallography, 18: 24107 (SC-T-64-903)
DESYATOVA, N. V., Gas evolution and double bonds during PIB radiolysis, 18: 23669
DEVARE, H. G., Decay of 4-hour activity of Zn-71, 18: 24657
DEVLIN, Thomas J., Elastic scattering of π^+ by protons, 18: 24453
DEVLIN, Thomas J., Elastic scattering of π^- by protons, 18: 24454
DIAMOND, R. M., Conference on reactions between complex nuclei, 3rd, Asilomar, California, 4/63, 18: 24707
DICKE, R. H., The sun's rotation and relativity, 18: 24287
DICKERSON, Ronald F., Prog. rpt. on civilian applications, 2/64, 18: 24988 (BMI-1665(Del.))
DICKINSON, J. M., Co-extrusion of refractory metal clad fuel elements, 18: 24101 (LAMS-3065)
DICZFALUSY, E., Influence of ovarian irradiation on urinary estrogens in breast cancer patients, 18: 23346
DIEBNER, Kurt, Method for the extraction of Pu or U-233, 18: 24929
DIEHL, Joerg, Strengthening of neutron-irradiated Cu single crystals, 18: 24200 (ANL-Trans-19)
DIETZ, H. B., Jr., Sodium–water reaction in SRE pipe gallery, 18: 24894 (NAA-SR-Memo-7743)
DILLENBURG, D., Spin relaxation in x-γ angular correlations, 18: 24653
DILLEY, J., Effects of 2-imino-thiazolidine-4-carboxylic acid on radioprotective activity of agents, 18: 23353 (NP-13918(p.42-57))
DILWORTH, C., Analysis of tracks created in Pb-plate spark chamber, 18: 23973
DIMMLER, G., Multichannel analysis by use of an on-line computer, 18: 23859
DIONISIO, Jose Sant'ana, Contribution to study of spectra of low-energy electrons, 18: 24408
DIPERT, Merlin H., Program to simulate two-component chromatogram, 18: 23195 (ANL-6823(p.152-6))
DMITRIEV, R. V., Isotopic exchange of H in hydrocarbons on rare earth oxides. II., 18: 23573
do Amaral, C. Marcio
see Marcio do Amaral, C.
DOBROSEL'SKAYA, N. P., Catalytic dehydration of cyclohexanol over $MgSO_4$ containing Pa-231, 18: 23672
DOBROSEL'SKAYA, N. P., Effect of radiation of S-35 and Mo-99 on size of specific surface of MoS_2, 18: 23696
DO CARMO ANTA, Maria, Yields of H_2O_2 from radiolysis of aqueous solutions, 18: 23675
DODDS, Wellesley, Prog. rpt. on magnetically confined plasma duplexer, 5–8/63, 18: 24740 (AD-426769)
DOGANGES, Paul T., Degradation of proteinpolysaccharide from cartilage, 18: 23217
DOHNALEK, J., Method of decontamination of clothes, 18: 23830
DOIDA, Y., Reactivation of x-irradiated mouse L cells, 18: 23367
DOLGOV, V. M., Structural changes and physical properties of reactor IRT-2000, 18: 24960 (NP-13911)
DOMINGO, V., Verification of direction of arrival of EAS, 18: 24344
DOMINGUEZ VIGO, Francisco, Measurement of H-alpha flare spectrograms, 18: 24271 (NP-13803)
DONAVEN, T. W., Internal fuses for power reactors, 18: 24876 (APEX-142)
DONNACHIE, A., Photodisintegration of deuteron, 18: 24416
DORFMAN, Leon M., Transient spectra and rate constants in oxygenated aqueous solutions, 18: 23678
DORMAN, L. I., Effect of small bursts in cosmic-ray hard component, 18: 24334
DORNFELDT, Wolfram, Tritium labeling of Artemisia ketones, 18: 23564
DOROSHEK, S. I., Effects of Mo on abnormalities in hardening Invar-type alloys, 18: 24159
DOROSZEWSKI, Jan, Distribution of I-131 in thyroid gland, 18: 23218
DOTHAN, Y., Processes forbidden by the G_2 symmetry, 18: 24441
DOTSON, J. P., Use of guard ring shields on negatively biased Langmuir ion collection current probes, 18: 24756 (NP-13946)
DOUGHERTY, D. E., Theoretical experiment in subcooled nucleate boiling, 18: 23769 (TID-19075)
DOULL, J., Chemical radioprotection against absorber-moderated protons, 18: 23357 (NP-13918(p.107-15))
DOULL, J., Dose-mortality relationships for radioprotective agents, 18: 23355 (NP-13918(p.75-98))
DOULL, J., Effects of 2-imino-thiazolidine-4-carboxylic acid on radioprotective activity of agents, 18: 23353 (NP-13918(p.42-57))
DOULL, J., Effect of 2-mercaptoethylamine or para-aminopropiophenone in diets of irradiated mice, 18: 23358 (NP-13918(p.116-28))
DOULL, J., Influence of chemical compounds on radiation lethality in mice, 18: 23354 (NP-13918(p.58-74))
DOWNS, William L., Renal function in Nb-poisoned rats, 18: 23203 (UR-646)
DRAGHCHESKU, M., Polarization of protons in single crystals of LaMg double nitrate, 18: 23444 (JINR-P-1626)
DRAGHCHESKU, P., Polarization of protons in single crystals of LaMg double nitrate, 18: 23444 (JINR-P-1626)
DRAIN, L. E., Nuclear magnetic resonance of V, 18: 24688
DRAWIN, Hans-Werner, Ionization and recombination in H-, He-, and Li-plasma, 18: 24751 (EUR-CEA-FC-200)
DRESDEN, M., Contrasts and conflicts of S matrix and field theory, 18: 24483 (SUI-63-21)
DRESSER, D. L., Analysis of thermionic converters, 18: 24360 (ANL-6802(p.126-43))
DRIESSENS, J., Intravenous injections of Guerin epithelioma. VI., 18: 23264
DRISKO, R. M., Distorted-wave theory of stripping reactions, 18: 24667
DRISKO, R. M., Elastic and inelastic scattering of C from C, 18: 24710
DRISKO, R. M., Pickup of heavy clusters, 18: 24714
DROWART, John, Vaporization of alloys at high temperatures, 18: 23455 (WADD-TR-60-782(Pt.XXII))
DUBINSKI, Ye., Determination of the cosmic-ray equator, 18: 24329
DU BOIS, Andrew O., Electron beam furnace, 18: 23758
DU BOIS, Kenneth P., Influence of steroids on radiation-sensitive detoxification systems, 18: 23352 (NP-13918(p.28-41))
DUBOVOI, L. V., Generation of superfast plasma bundles in linear accelerator, 18: 24775
DUBOW, A. A., Nucleon-nucleon elastic scattering matrix. I., 18: 24403 (UCRL-7563-T)
DUBROVINA, Z. V., Calculation of skeleton activity by Sr-90 content of bones, 18: 23224
DUCHEMIN, J. P., Semiconductor, low-resolution time counters, 18: 23864
DUCKWORTH, H. E., Mass effect corresponding to nuclear deformation in region $N \sim 90$, 18: 24681
DUCKWORTH, W. H., Refractory ceramics of interest in aerospace structural applications, 18: 24141 (RTD-TDR-63-4102)
DUFFIE, J. A., Solar energy conversion, 18: 24353 (ANL-6802(p.24-5))
DUFRANE, Kenneth, Underwater thermoelectric reactor plant, 18: 24903 (NP-13900(Sect.10))
DUGAS, Ronald, PM-1 plant packaging, 18: 24896 (NP-13900(Sect.1))
DUMAS, J.-C., Fast transistorized electronic complex, 18: 24266
DUPARC, D. M., Interaction of H and He atoms, 18: 24313
DUQUESNE, M., Single photoelectron pulse spectra, 18: 23857
DURBIN, Patricia W., Tumor induction with At-211 in rats, 18: 23261
DURHAM, F. E., Angular-momentum effects in compound-nucleus reactions, 18: 24726
DUTREIX, A., Dose in vicinity of interface between two media exposed to x rays, 18: 23388
DUTRIEX, J., Dose in vicinity of interface between two media exposed to x rays, 18: 23388
DWORNIK, Stephen E., Conference on detection of underground objects, Ft. Belvoir, 3/62, 18: 23781 (NP-13943)
D'YACHKOVA, R. A., Catalytic dehydration of cyclohexanol over $MgSO_4$,

containing Pa-231, 18: 23672

D'YACHKOVA, R. A., Extraction of Pa, Zr, and Nb n-benzoylphenylhydroxylamines, 18: 23728

DYER, Charles H., Detection of underground objects by backscattered radiation, 18: 23782 (NP-13943(p.117-27))

DYER, Frank F., Second-order interference in activation analysis, 18: 23428

DYER, John N., Track measurements with digitized microscope, 18: 23940

DYKES, P. W., Effect of x-irradiation on posterior pituitary, 18: 23275

DZHORDZHIO, N. V., Geophysical investigations by means of Cosmos 3 and 5, 18: 24328

DZHORDZHIO, N. V., Some characteristics of geoactive particles, 18: 24327

DZHURAKULOV, Kh., Energy distribution of electrons ejected by Ne atoms and ions, 18: 24318

E

ECKERT, R. J., Computer code for thermodynamic analysis for W and Re vapor plating, 18: 23451 (UCRL-7667)

EDELMANN, Abraham, Influence of gonadectomy, sex and strain upon survival times of x-irradiated mice, 18: 23347

EDVARSON, Kay, Radioactivity measurements on food, 1962, 18: 23790 (NP-13828)

EDWARDS, Cecile H., Effect of irradiation on the tissue uptake of methionine-2-C^{14} and methionine methyl-C^{14}, 18: 23293

EDWARDS, Gerald A., Effect of irradiation on the tissue uptake of methionine-2-C^{14} and methionine methyl-C^{14}, 18: 23293

EDWARDS, John George, Improvements in reactor fuel elements, 18: 24837

EFENDIEV, G. Kh., Leaching U and Ra from clays, 18: 23711

EGER, H., Swelling measurements in development of emulsions, 18: 23555

EGIDI, A., Plasma measurements on IPM-A, 18: 24749 (CONF-521-2)

EHMERT, A., Effects of nuclear tests on vlf propagation, 18: 24540

EHRET, Charles F., Segregation of structural elements during cell division, 18: 23163 (ANL-6823(p.178-88))

EHRET, G., Rotating-crystal spectrometer for scattering experiments with slow neutrons, 18: 23879 (NP-13930(p.126))

EHRLICH, Robert, Parity conservation in Λ^0 production in C nuclei, 18: 24394 (NEVIS-122)

EIDSON, W. W., Integrated computer-analyzer system, 18: 23860

EIDUK, O. N., Structure of two-phase metal-powder solid alloys, 18: 24175

EIGEN, M., Kinetic behavior of protons and deuterons in ice crystals, 18: 23466

EISNER, P. N., Prog. rpt. on radiation effects on EM signals in air, 10–12/63, 18: 24300 (NP-13953)

ELBEK, B., Coulomb excitation of vibrational states in deformed nuclei, 18: 24729

ELBEK, B., Reaction C^{12}(C^{12},α)Ne^{20}, 18: 24724

ELDRIDGE, James S., Absolute determination of I-125, 18: 23390

ELKIND, Sidney, Final rpt. on nuclear rocket engine nozzle, 3/64, 18: 24940 (NASA-CR-54000)

ELLIOTT, J. H., Scattering of 65-Mev He ions from O-16, 18: 24623 (UCRL-10727)

ELLIOTT, Rodney P., Laves phases of rare earths with transition elements, 18: 24126 (CONF-405-32)

EL-NADI, M., Three-nucleon stripping process, 18: 24687

ELROD, H. G., Jr., Heat transfer effects in moderate accidents to fast reactors, 18: 24817 (NDA-14-134)

EMENDOERFER, D., Inelastic scattering cross sections on Na-23 to 4 Mev, 18: 24597 (NP-13930(p.15))

ENGELL, H. J., Chemisorption in reaction of gases with solids, 18: 25033 (SC-T-64-901)

ENGELMANN, R. J., Precipitation scavenging efficiencies for ZnS particles, 18: 24212 (HW-SA-3167)

EPSTEIN, Albert D., Mechanism of liquid-liquid settling, 18: 23452 (UCRL-10625)

EREMEEV, I. P., Thermalizing properties of water and certain organic compounds, 18: 24566 (NP-13912)

EREMENKO, E. V., Linear electron accelerator up to 90 Mev, 18: 24245 (NP-13914)

EREMENKO, E. V., 2-Bev linear electron accelerator, 18: 24248 (NP-13960)

ERICKSON, B. H., Effects of γ irradiation on primitive germ cells of prepubertal bovine testis, 18: 23278

ERICKSON, C. E., Re-entry flight demonstration number one, 18: 24941 (SC-RR-64-501)

ERMAKOV, V. A., Reactions of heavy elements with multicharged ions. II., 18: 24689

ERMAKOV, V. A., Yield of fission fragments from heavy nucleus fission. I., 18: 24690

ESCOBAR, I., Existence of extensive showers of primary γ radiation, 18: 24342

ESCOBAR, I., Intensity of cosmic radiation and EM states of interplanetary space, 18: 24345

ESCOBAR, I., Properties of EAS at 4200 meters, 18: 24343

ESCRIVE, R., CABRI—experimental swimming pool reactor, 18: 24963

ESTEVE, A., Conformal group in Minkowsky space, 18: 24498

ESTRADA, J., Coefficients of diffusion in UO$_2$SO$_4$–anion exchange resin systems, 18: 23710

EWALD, H., Action of ion beams on nuclear emulsions, 18: 23916

EXSTEEN, G., Vaporization of alloys at high temperatures, 18: 23455 (WADD-TR-60-782(Pt.XXII))

EYRE, B. L., Studies of UC$_2$ precipitates in UC single crystals, 18: 23556

EYRICH, W., Neutron generator with duoplasmatron ion source, 18: 24247 (NP-13930(p.140))

EYRING, LeRoy, Phase reactions in TbO$_x$–O$_2$ and related systems, 18: 23505

EYSSELT, M., Method of decontamination of clothes, 18: 23830

F

FABRE, Claude, Separation of at least one constituent from gaseous mixture, 18: 23737

FABRICAND, B. P., Proton relaxation times in alkali halide solutions, 18: 23559

FADINA, E. V., Properties of fine-grain nuclear emulsions, 18: 23498

FAIZULLOV, F. S., Air, N, and Ar behind a shock wave, 18: 24235

FAIZULLOV, F. S., Gas states behind reflected shock waves, 18: 24236

FALCETTI, E., Distribution of Na thiocyanate for tumor bearers exposed to irradiation. I., 18: 23285

FALTER, Kenneth H., Strontium-90 content of human bones 1961-63, 18: 23833

FALYBRUKH, K. M., Spin correlation coefficients in elastic 315-Mev scattering, 18: 24389 (JINR-P-1617)

FANTE, Ronald L., Spectral density of radiation scattered by nonequilibrium plasma, 18: 24752 (MATT-217)

FARLEY, John A., Delay of postirradiation test fluids: factor in saccharin avoidance behavior, 18: 23290

FARRAR, J. P., Reactor physics startup test of Indian Point reactor, 18: 24877 (BAW-189)

FARWELL, G. W., Location in 4$^-$ level in Zr-90, 18: 24661

FASSELL, W. M., Jr., High-temperature tensile properties of ZTA grade graphite, 18: 24145 (WADD-TR-61-72(Vol.XIV))

FEDERIGHI, T., Pre-precipitation rate in Al–Zn alloy, 18: 24206

FEDORENKO, N. V., Dissociation of H$_2^+$ ions in collision with atoms and molecules, 18: 24324

FEDOROV, B. A., Functional condition of cortical layer of suprarenals in radiation sickness, 18: 23322

FEDOROVA, G. V., Uptake of C-14 by developing spawn and young of freshwater fish, 18: 23223

FEDOROVA, L. A., Oxidation of U(IV) in perchloric acid solutions, 18: 23541

FEDULOVA, A. A., Synthesis of plutonyl carbonates, 18: 23538

FEDYAKINA, N. I., Type-II absorption and magnetic field disturbance, 18: 24520

FEHRENBACHER, L. L., Stabilization of cubic zirconia, 18: 23503

FEIGELSON, R. S., Magnetic susceptibility of GdPO$_4$, TbPO$_4$, and DyPO$_4$, 18: 23512

FEINAUER, E., SPERT transient pressure measurements, 18: 24954 (IDO-16930)

FEINGOLD, David A., Program for prediction of hydrodynamic flow oscillations, 18: 23767 (KAPL-M-6149)

FEINSTEIN, Robert N., Effect on catalase of compounds related to aminotriazole, 18: 23187 (ANL-6823(p.91-8))

FEINSTEIN, Robert H., Reduction of erythrocyte catalase level. II., 18: 23186 (ANL-6823(p.86-90))

FELDMAN, K. T., Jr., Acoustically resonant Stirling engine, 18: 24364 (ANL-6802(p.166-9))

FEL'DSHTEYN, Ya. I., Visual observations of auroras, 18: 24529

FELST, R., Reaction (d,n) on Be-9, B-10, B-11, Si-28, and P-31, 18: 24611 (NP-13930(p.132-3))

FELST, R., Time-of-flight spectrometer for fast neutrons, 18: 23882 (NP-13930(p.144-6))

FERGUSON, Robert L., Independent fission yield of Sb-127, 18: 24677

FERRELL, Richard A., Superconductivity in a strong-spin exchange field, 18: 24563

FERRIS, H. D., Advanced test reactor fuel plate pressure deflection tests, 18: 24963 (TID-20621)

FERRO-LUZZI, M., Production mechanism for reaction K$^+$p → K$^+$p at 3 Bev/c, 18: 24449

FETISOV, V. N., Photodisintegration of H-3, 18: 24705

FEWSON, Charles A., Triphosphopyridine nucleotide reduction by spinach chloroplasts, 18: 23198 (ANL-6823(p.191-8))

FICHARDT, T., Liquid radioactive waste disposal at hospital, 18: 24985

FICHTEL, C. E., Application of nuclear emulsions to space research, 18: 23955

FICHTEL, C. E., Rigidity spectra of solar cosmic rays, 18: 24326

FICKINGER, W. J., Production of two charged pions in 871-Mev π^--p interactions, 18: 24418

FIEBIGER, N., Nuclear physics investigations by the (n,γ) reaction, 18: 24607 (NP-13930(p.104-8))

FIELD, F. H., Benzene production in radiation chemistry of acetylene, 18: 23676

FIKS, V. B., Ion entrainment by electrons in metals, 18: 24167

FILIPPOV, G. M., Propagation of electromagnetic waves through laminated media, 18: 24808

FINK, H. J., Vortex wave spectrum of type-II superconductor, 18: 24556

FINK, R. W., Nuclear reactions induced by 14.7-Mev neutrons, 18: 24613 (NP-13930(p.139))

FINKEL, A. J., Potentiation of chemotherapy of tumors by D_2O, 18: 23209

FINKEL, Miriam P., Parameters of radiation dosage that influence osteogenic sarcomas, 18: 23231 (ANL-6823(p.20-43))

FINLAY, Roger W., Circular polarization measurements in Eu-154, 18: 24668

FINN, M. C., Phase transition region of $PrO_{1.8}$, 18: 23504

FIOCK, W. L., Prog. rpt. on nuclear superheat, 8–10/63, 18: 24884 (GEAP-4419)

FIORONI, F., Ispra-2—description and safety, 18: 24962 (RT/ING(63)-25)

FIORONI, F., Monitor for exposure dose intensity, 18: 23889 (RT/EL(64)-1)

FISCHER, A. K., Hydride and bimetallic regenerative EMF cells, 18: 24355 (ANL-6802(p.53-63))

FISCHER, J., Scattering of pions on pions in threshold region, 18: 24413

FISCHER, L., Electric mobility of $^{42}K^+$ in aqueous KNO_3 solutions, 18: 23467

FISCHER, P., Structure of peritectic Pr–Fe and Nd–Fe compounds, 18: 24184

FISCHER-HJALMARS, Inga, Prog. rpt. on electronic structures and states of molecules and crystals, 3/62–2/63, 18: 24296 (AD-417517)

FISHMAN, Frank, Steady MHD flow through channel of circular section, 18: 23773

FISHMAN, J. B., Application of nuclear techniques to the manufacture of high-reliability printed circuit boards, 18: 23841 (TID-20183)

FITZGERALD, C. L., Removal of Hg from radioactive waste solutions, 18: 24977 (ORNL-TM-827)

FITZWATER, D. R., Consequent procedures in convention computers, 18: 24992 (IS-904)

FLAMM, D., Requirements of self-consistency in quantum field theories, 18: 24499

FLEISCHER, Edward S., Remote pipetters for hot-cell enclosures, 18: 23842 (UCRL-9661)

FLEISCHER, R. L., Uranium contents of ancient man-made glass, 18: 23547

FLEMING, Dale M., Radioactivity measurements in Alaskan Eskimos in 1963, 18: 23834

FLEMING, Kurt, Radiation protection effects of chlorotrianise, 18: 23371

FLEROV, G. N., Spontaneously fissioning isomer produced in reactions with charged particles, 18: 24725

FLEW, E. M., Control of H-3 in D_2O in DIDO-class reactors, 18: 23812 (AERE-R-4528(p.35-47))

FLEW, E. M., Health physics control of research reactors, 18: 23809 (AERE-R-4528)

FLEW, E. M., Monitoring techniques and radiation spectrometry in contamination control, 18: 23811 (AERE-R-4528(p.25-33))

FLODMARK, Stig, Prog. rpt. on electronic structures and states of molecules and crystals, 3/62–2/63, 18: 24296 (AD-417517)

FLOWERS, B. H., Even-parity levels of mass-18 nuclei, 18: 24685

FLYGARE, K. A., Reducing volume of low-level radioactive waste, 18: 24986

FLYNN, E. R., (He^3,n) reactions on various light nuclei, 18: 24650

FLYNN, P. W., Prog. rpt. on effect of neutron irradiation on materials, 10/63–1/64, 18: 24190 (GA-5037)

FODOR, L., Interstellar neutrino density and cosmogony, 18: 24273

FOJTIK, M., Separating elements of alkaline earth group on ion exchangers, 18: 23421

FOLLIN-ARBELET, A., CABRI—experimental swimming pool reactor, 18: 24969

FOMIN, P. I., Double bremsstrahlung in case of almost collinear momenta, 18: 24704

FORSEN, Sture, Nuclear spin-coupling constants in tiglaldehyde, 18: 23572

FOSTER, E. L., Jr., Re-entry burnup of hydrided Zr–U, 18: 24185

FOSTER, M. S., Hydride and bimetallic regenerative EMF cells, 18: 24355 (ANL-6802(p.53-63))

FOWLER, Eric B., Fixation of atomic wastes in inert solid materials, 18: 24976 (LADC-6398)

FOWLER, William A., Relativistic astrophysics, 18: 24277

FOX, David, Higher-order spacing distributions for a class of unitary ensembles, 18: 24679

FRADKIN, G. E., Stability of functionally inhomogeneous sections of DNA to radiation, 18: 23269

FRADKIN, M. I., Controlled exposure of nuclear emulsions on sputniks, 18: 23957

FRADKIN, M. I., Cosmic rays and radiation belts, 18: 24347

FRAEMBS, D. H., Critical experiment P127, 18: 24845 (APEX-638)

FRAHN, W. E., Polarization of spin-½ particles. I., 18: 24636

FRANA, J., Radioactive decay of Ni-65, 18: 24639

FRANKE, W., Back-scattering proton spectrometer for measuring fast neutron spectra, 18: 23883 (NP-13930(p.147-57))

FRANKE, Wilhelm, Oxidation ferments from higher plants. II., 18: 25023 (ANL-Trans-21)

FRANZINI, Paolo, Lifetimes of massive triplets, 18: 24467

FREDRIKSSON, Lars, Radioactivity measurements on food, 1962, 18: 23790 (NP-13828)

FREEBREY, P. D., Device for displaying distribution of positron-emitting nuclides *in vivo*, 18: 23903

FREER, John, Improvements in gas-operated grabheads, 18: 24833

FREHSE, Helmut, Oxidation ferments from higher plants. II., 18: 25023 (ANL-Trans-21)

FRESCURA, T., Inactivation of aphthous virus by radiation, 18: 23246 (AERE-Trans-1000)

FRETWURST, E., Energy dependence of neutron cross sections, 18: 24602 (NP-13930(p.43-9))

FREUND, P. G. O., Requirements of self-consistency in quantum field theories, 18: 24499

FRICKER, H. W., Dry friction in gas bearings and shaft seals, 18: 23742 (TID-7690(p.106-20))

FRIEDBERG, F., Effects of γ radiation on ribonuclease, 18: 23295

FRIESER, H., Particle photography. IV., 18: 23904

FRIESER, H., Swelling measurements in development of emulsions, 18: 23555

FRIGERIO, Norman A., Heavy metal compounds as fixatives for electron microscopy, 18: 23162 (ANL-6823(p.174-7))

FRISIUS, J., Effects of nuclear tests on vlf propagation, 18: 24540

FRIZ, G., Physical properties of OM_2 for heat transfer purposes, 18: 23569 (EUR-1619.e)

FROEHLICH, H., Boltzmann equation in electron-phonon systems, 18: 24557

FRONTEROTTA, G., Use of internal beam of synchrotron for study of reaction (e,e' p), 18: 24243 (ISS-63/42)

FRYE, Glenn M., Etching effects during processing, 18: 23928

FUDA, M. G., FORDRAM—program to calculate group average microscopic resonance absorption and fission cross sections, 18: 24589 (KAPL-M-6131)

FUEKI, Kenji, Electrolytic dissociation of aliphatic amines by β bombardment, 18: 23608 (AEC-tr-6316(p.232-7))

FUHS, A. E., Thermal ionization and electronegative species, 18: 23532

FUJIMOTO, Hiroshi, Gamma and electron irradiation of clays and soils, 18: 23171

FUJIMOTO, Hiroshi, Gamma irradiation of onion bulbs, 18: 23255

FUJIMOTO, Hiroshi, Measuring tritiated H_2O in soils, 18: 23419

FUJISHIRO, Masatoshi, Measurement of short-lived isotope, 18: 24637

FUJISHIRO, Masatosi, Beta spectra of Ce-144, 18: 24222

FUJITA, Akira, Artificial radioactive dust particles collected by an electrostatic precipitator, 18: 23796

FUJITA, Akira, Observation fallout, 18: 23793

FUJITA, Akira, X-ray microanalysis of highly radioactive fallout particles, 18: 23794

FUJIWARA, Yuzuru, Free radicals from polymers irradiated with UV, 18: 23653 (AEC-tr-6316(p.598-602))

FUJIWARA, Yuzuru, Free radical formation in polymers, 18: 23654 (AEC-tr-6316(p.609-15))

FUJIWARA, Yuzuru, Saturation factor of free radicals, 18: 24220 (AEC-tr-6316(p.603-8))

FUKAI, Rinnosuke, Strontium-90 content of marine organisms, 18: 23792 (WP/37)

FUKAI, Rinnosuke, Strontium-90 in marine organisms, 18: 23212

FUKATKO, T., Acceleration of α particles in cyclotron U-120, 18: 24260

FUKUDA, Kyue, Delayed neutron yield from U target bombarded by electrons, 18: 24574

FUKUDA, Kyue, Liquid flowing neutron monitor, 18: 23896

FULDE, Peter, Superconductivity in a strong-spin exchange field, 18: 24563

FULLER, D. D., Pressure distribution in gas-lubricated, tilting-pad, journal bearings, 18: 23747 (TID-7690(p.273-302))

FUMELLI, M., High-vacuum Li discharge, 18: 24750 (EUR-1627.f)

FURET, Jacques, Period safety trip during reactor startup, 18: 24814 (CEA-R-2411)

FURNAS, Thomas C., Jr., Radiography of C and graphite, 18: 24146 (WADD-TR-61-72(Vol.XVII))

FURSOV, G. D., Ionization energy losses by fast electrons in thin polystyrene layers, 18: 24702

FURSOV, G. L., Linear electron accelerator up to 90 Mev, 18: 24245 (NP-13914)

FURTH, Jacob, Tumor induction with At-211 in rats, 18: 23261

FURUTA, Junichiro, Discharge figures in dielectrics by electron irradiation. II., 18: 24203

FURUTA, Junichiro, Measurement of short-lived isotope, 18: 24637

FURUTA, Junichiro, Response of ionization chamber in pulsed beam, 18: 23897

FUSHCHICH, V. I., Poles of generation amplitude for $\pi + d \to d + \pi + \pi$, 18: 24470

FUTTERER, Arnold T., Neutron reflection and flux versus depth for Al, 18: 24564 (BRL-1238)

G

GADEK, V., Determination of the cosmic-ray equator, 18: 24329

GADSDEN, Evelyn L., Effect of irradiation on the tissue uptake of methionine-2-C^{14} and methionine methyl-C^{14}, 18: 23293

GAERTTNER, E. R., Prog. rpt. on linear accelerator project, 1–3/64, 18: 24571 (RPI-328-6)

GALE, N. H., Nuclear reaction studies with Li ions on B-10 and B-11 targets, 18: 24720

GALEEV, A. A., Transition radiation from uniformly moving charge passing through diffuse interface, 18: 24480

GALLAGHER, W. J., Alpha-particle voltmeter, 18: 23846

GALLI, S., Ispra-2—description and safety, 18: 24962 (RT/ING(63)-25)

GAL'PERIN, Yu. I., Geophysical investigations by means of Cosmos 3 and 5, 18: 24328

GAL'PERIN, Yu. I., Some characteristics of geoactive particles, 18: 24327

GAMBARDELLA, G., Ispra-2—description and safety, 18: 24962 (RT/ING(63)-25)

GAMBOA, J. M., Radiochemical purity of solutions of phosphates and pyrophosphates, 18: 23417

GANDY, H. W., Radiationless resonance energy transfer from UO_2^{2+} to Nd^{3+}, 18: 24223

GARCIA, Antonio Leite, Nuclear power in Portuguese generating system, 18: 24922

Garcia Ontiveros F., Angel
see Angel Garcia Ontiveros, F.

GARDINER, R. L., Health physics control of research reactors, 18: 23809 (AERE-R-4528)

GARDINER, R. L., Monitoring techniques and radiation spectrometry in contamination control, 18: 23811 (AERE-R-4528(p.25-33))

GARG, J. B., Neutron resonance spectroscopy. III., 18: 24673

GARIBYAN, G. M., Ionization energy losses by fast electrons in thin polystyrene layers, 18: 24702

GARIN, A., Alpha-proton discrimination in emulsions, 18: 23932

GARRETT, W. R., Elastic scattering of slow electrons from alkali atoms, 18: 24298 (N64-13373)

GARUTT, V. E., Age of mammoth and woolly rhinoceros fossil remains by C-14 dating, 18: 23788

GARVEY, Gerald T., Scattering of 168-Mev O-16 nuclei from C-12, 18: 24709

GARY, Robert, Thermodynamics of DCl in D_2O, 18: 23484

GARYTH HUGHES, Making impermeable composite carbon tube, 18: 24117

GASSNER, F. X., Effects of ionizing radiation on reproductive system, 18: 23175

GASSNER, F. X., Effect of testicular x irradiation on bull semen, 18: 23337

GATTI, E., Converter for pulse analysis, 18: 23851

GATTI, Raymond C., Fission barrier of Tl-201, 18: 24670

GAUGGEL, R., Karlsruhe Van de Graaff project for fast neutrons, 18: 24246 (NP-13930(p.137-8))

GAUK, Wieslaw, Control rods with sintered boron carbides, 18: 24974

GAVRILOV, K. A., Extraction properties of Fm and Md, 18: 23725

GAYLITIS, A. K., Cyclotron acceleration of relativistic particles, 18: 24252 (JPRS-24633(p.26-42))

GEBBIE, H. A., Far infrared spectra of molecular crystals. I., 18: 23558

GEERAETS, W. J., Light source for production of retinal burns, 18: 23254

GEIBEL, J. A., Forward production of photons from 9-Bev π-p interactions, 18: 24417

GEINTS, A. E., Age of mammoth and woolly rhinoceros fossil remains by C-14 dating, 18: 23788

GELETSEANU, I., Thorium acetates, 18: 23543

GELFAND, N., Neutral decay and isotopic spin of the f^0, 18: 24463

GEL'MAN, A. D., Separation of Np-239 from irradiated U, 18: 23726

GENS, T. A., Recovering U by solvent extraction from solution of chlorination products, 18: 23703 (ORNL-TM-789)

GENTNER, W., Gamma-ray studies of B-11, N-14, and F-19 induced transfer reactions, 18: 24721

GEORGE, A. M., Electrical conductivity and thermoelectric power of δ-U_3O_8. II., 18: 24120 (AEET/CD/21)

GEORGE, R., Production mechanism for reaction $K^+p \to K^{*}p$ at 3 Bev/c, 18: 24449

GERARDO, J. B., Investigation of dense plasmas by laser radiation, 18: 24745 (ANL-6802(p.120-5))

GERASEEV, V. M., Laboratory measuring-registering center, 18: 23861

GERASIMOVA, G. K., Radiation effects on adaptation to rising temperature in surrounding media, 18: 23307

GERBER, G. B., Excretion of β-aminoisobutyric acid and creatine after irradiation, 18: 23234 (EUR-591.d)

GERSTEIN, I. S., Bound states and elementary particles in the limit $Z_1 = 0$, 18: 24458

GERSTEIN, I. S., Generalization of Chew's reciprocal bootstrap to SU(3), 18: 24431

GERSTEIN, I. S., Meson–baryon resonances in $U(3) \otimes U(3)$ symmetry, 18: 24465

GESTSON, Donald Kermite, Marine ship reactor, 18: 24946

GHIGO, G., Photofission of Bi, W, and Ag, 18: 24655

GHIORSO, A., Conference on reactions between complex nuclei, 3rd,

Asilomar, California, 4/63, 18: 24707
GIAUX, G., Intravenous injections of Guerin epithelioma. VI., 18: 23264
GIBBS, Martin, Triphosphopyridine nucleotide reduction by spinach chloroplasts, 18: 23198 (ANL-6823(p.191-8))
GIERTS, G., Response of ionographic emulsions in analysis of fast neutrons, 18: 23960
GILAT, Jacob, Recoil range straggling of heavy ion reaction products in He, 18: 24734
GILBERT, W. S., Safety analysis for Super Kukla Prompt Burst Reactor, 18: 24964 (UCRL-7695)
GILES, Virginia M., Determination of Ni in Th metal, 18: 23414 (Y-1464)
GILL, P. S., Directional distribution of cosmic-ray hard component, 18: 24337
GILL, S., Structures for nuclear power, 18: 24926
GILLET, C., Radioprotective effects of alkaline earth chlorides on barley, 18: 23368
GILLET, Claude, Action of x radiation on *Chara vulgaris* L. V., 18: 23287
GILLETTE, E. L., Effect of testicular x irradiation on bull semen, 18: 23337
GINDIN, I. A., Creep rate of Ni after prior deformation at 4.2°K, 18: 24136 (NP-13909)
GINGERICH, Karl A., Praseodymium–group V compounds. II., 18: 23510
GINTHER, R. J., Radiationless resonance energy transfer from UO_2^{2+} to Nd^{3+}, 18: 24223
GINTSBURG, M. A., Low-frequency waves in multicomponent plasma, 18: 24778
GINZBURG, F. L., Absorption of radioactive isotopes from aqueous and water–ethanol solutions, 18: 23724
GINZBURG, N. I., Effect of high pressure on superconducting properties of Zr, 18: 24560
GINZBURG, V. L., Cosmic rays and radiation belts, 18: 24347
GINZBURG, V. L., Data on radioastronomy, 18: 24293
GINZBURG, V. L., Performance of magnetic thermonuclear reactor, 18: 24797
GIRARD, Bernard Rene, Solvent purification in plants treating irradiated fuels, 18: 23698 (CEA-R-2404)
GISSANE, W. J. M., Spectrum of gaseous ScF, 18: 23531
GIST, Clayton S., Effects of cratering test on lizards, 18: 23181 (UCLA-12-522)
GITTUS, J. H., Irradiation-induced growth in Al–Fe–U alloys, 18: 24204
GLASS, D. N., ESADA fuel fabrication, 18: 23404 (AI-8700(Vol.V))
GLAZUNOV, M. P., Separation of Np-239 from irradiated U, 18: 23726
GLOECKLE, W., Inelastic scattering cross sections on Na-23 to 4 Mev, 18: 24597 (NP-13930(p.15))
GLOEDE, P., Properties of radio aurorae in medium latitudes, 18: 24536
GODEAU, A., Excitation and ionization in rare gases, 18: 23972
GOELLER, Jack, Material and design considerations in PM-1 vessel, 18: 24897 (NP-13900(Sect.2))
GOLDANSKII, V. I., Production of delayed proton emitters in reactions between complex nuclei, 18: 24736
GOLDBERG, H., On $\pi^{\pm}p$ and pp elastic scattering, 18: 24424
GOLDBERG, S. S., Proton relaxation times in alkali halide solutions, 18: 23559
GOLDEMBERG, J., Excitation of giant resonance in C-12 and O-16, 18: 24671
GOLDEMBERG, J., Form factors for strong M1 transitions in light nuclei, 18: 24675
GOLDFARB, L. J. B., Finite range effects in deuteron stripping processes, 18: 24686
GOLDHABER, G., K-N interaction in the I = 0 state at low energies, 18: 24457
GOLDHABER, S., K-N interaction in the I = 0 state at low energies, 18: 24457
GOLDRING, G., Excitation functions for coulomb excitation of 2+ and 4+ rotational levels in Sm-152, 18: 24727
GOLDSCHMIDT-CLERMONT, Y., Production mechanism for reaction $K^{+}p \rightarrow K^{+}p$ at 3 Bev/c, 18: 24449
GOLDSZTEIN, Marcel, Uranium content of western Mediterranean, 18: 23787
GOLICHENKOV, V. A., Experimental, radiation-induced cataract in frogs, 18: 23268
GOMBAS, P., Statistical theory of atomic nuclei. V., 18: 24633
GONZALES DE DOMINGUEZ, Wilma, Measurement of H-alpha flare spectrograms, 18: 24271 (NP-13803)
GOODE, J. H., Separation and recovery of U and Pu from fission products, 18: 23704 (ORNL-TM-828)
GORDON, Arnold J., Racemization of 9,10-dihydro-4,5-dimethylphenanthrene, 18: 23574
GORDON, E., Prog. rpt. on fuel cycle development, 10/52–6/63, 18: 24860 (UNC-5071)
GORDON, S., Ultraviolet spectra of transients produced in radiolysis of aqueous solutions, 18: 23683
GORDON, Solon A., Triphosphopyridine nucleotide reduction by spinach chloroplasts, 18: 23198 (ANL-6823(p.191-8))
GORDY, Walter, Radiation effects on proteins and their constituents, 18: 23289
GORICHEV, P. A., Discrimination of heavy ions in nuclear emulsion, 18: 23954
GORKOV, L. P., Ferromagnetism in superconducting alloys, 18: 24561
GORSKII, N. I., Separation of Sr from Ca, 18: 23721
GOSWAMI, Mahendra N. D., Activation and inactivation of liver *p*-hydroxyphenylpyruvic acid oxidase, 18: 25009 (TID-19079)
GOTTLIEB, P., Many-body theory of localized d states in metals. II., 18: 24170
GOURDIN, M., Deuteron electromagnetic form factors, 18: 24439
GOURSKY, V., Linear gate and fast pulse-height coding system, 18: 23852
GOWEN, John W., Acute irradiation effects on reproductivity of mice, 18: 23325
GOWEN, John W., Effects of irradiation over ten generations on reproductivities of mice, 18: 23329
GOZA, E. R., Detection of low-intensity radiations with nuclear emulsions, 18: 23921
GRAESSER, W., Grain growth in nuclear track emulsions, 18: 23493
GRAEVE, Rolf, Racemization of 9,10-dihydro-4,5-dimethylphenanthrene, 18: 23574
GRANT, I. S., Elastic scattering and reactions of Li ions, 18: 24325
GRAY, D. L., Tests using hydrostatic gas bearings, 18: 23748 (TID-7690 (p.303-12))
GRAY, F. L., Design optimization of thermoelectric devices, 18: 24376
GREEN, J. H., Hydride ion transfer and radiolysis in pentane and isopentane, 18: 23677
GREENBERG, J. S., Perturbations in nuclear collective motion, 18: 24730
GREENE, Alden G., Index to conferences relating to nuclear science, 18: 25005 (TID-4043(Rev.1))
GREENWOOD, G. W., Grain-boundary mobility, 18: 23566
GREER, G., Nuclear emulsion plate "shuffler", 18: 23847
GREIDER, K. R., Direct-interaction processes and simple approximation methods, 18: 24400 (NYO-1807-9)
GREIG, J. R., Emission-line profile measurements in transient plasmas, 18: 24791
GREIG, W. R., Effects of x irradiation on rat thyroid gland, 18: 23260
GREIM, L., Threshold detectors for fast neutron fluxes, 18: 23885 (NP-13930(p.178-80))
GREIM, M., Back-scattering proton spectrometer for measuring fast neutron spectra, 18: 23883 (NP-13930(p.147-57))
GRENON, Michel, Liquid-pressure regulating devices, 18: 23867
GRIBOV, V. N., Peculiarities of partial waves near J = I and asymptotics of amplitude of elastic scattering, 18: 24395 (NP-13872)
GRIFFIN, Bobby I., Radioactivity measurements in Alaskan Eskimos in 1963, 18: 23834
GRIGOR'EV, E. P., Half life of Tb-157, 18: 24696
GRIGOROVICH, Z. I., Solubility of gypsum in solutions of La, Pr, Nd, and Sm chlorides, 18: 23536
GRILLI, M., Polarization of Λ^0 from $\gamma + p = K^{+} + \Lambda^0$, 18: 24428
GRIN, G. A., Angular distribution inelastic diffusion of neutrons in C, 18: 24603 (NP-13930(p.51-3))
GRINEVICH, F. A., Performance possibilities and operating experience with water/water reactor, 18: 24958 (NP-13907)
GRISHAEV, I. A., Injection accelerator of electrons with constant phase velocity, 18: 24244 (NP-13908)
GRISHAEV, I. A., Ionization energy losses by fast electrons in thin

polystyrene layers, 18: 24702

GRISHAEV, I. A., Linear electron accelerator up to 90 Mev, 18: 24245 (NP-13914)

GRISHAEV, I. A., 2-Bev linear electron accelerator, 18: 24248 (NP-13960)

GRITCHENKE, Z. G., Investigation of Ru-103 and Ru-106 content of mixture of fission products, 18: 23886 (NP-13965)

GRITSYUK, Yu. N., Number of neutrons emitted by U-235 fission fragments, 18: 24701

GRITZ, E. E., Dynamic decomposition of rare-earth oxalates, 18: 23507

GRIZODUB, Yu. N., Propagation of harmonic perturbations in liquid which fills serially and parallely connected pump aggregate pipes, 18: 25024 (ANL-Trans-24)

GROCHULSKI, W., Stripping reactions in bombardment of Ta with Ne-20 ions, 18: 24717

GROSS, J., Radiobiological effect of ^{3}H-thymidine on DNA turnover, 18: 23215

GROSSMAN, L. N., Electrical insulators and spacers for nuclear thermionic devices, 18: 24367 (GEST-2022)

GROVE, G. R., Prog. rpt. on reactor fuels and materials, annual, 1963, 18: 24815 (MLM-1184)

GRUEBLER, W., Production of beam of polarized H^- ions, 18: 24680

GRUETER, Hans, Selective enrichment of Cs-137 in mushrooms, 18: 23183

GRUNBERG, G., Thin-film fast magnetic memories, 18: 23862

GRUZDEVA, L. A., Welding of Ti alloys, 18: 24106 (JPRS-24521(p.1-58))

GUBBINS, M. E., Monte Carlo computer program CEP for calculating collision probabilities in cuboids and finite cylinders, 18: 24377 (AEEW-M-442)

GUEBELI, O., Mixed adsorption of Rn on activated charcoal, 18: 23462 (SC-T-64-616)

GUEBELI, O., Radon adsorption with activated charcoal, 18: 25031 (SC-T-64-617)

GUERRY, DuPont III, Light source for production of retinal burns, 18: 23254

GUILLON, H., Linear gate and fast pulse-height coding system, 18: 23852

GUINEA, M., Ionographic study of reactions of neutrons on C, 18: 24642

GUINIER, A., Point-by-point study of surface of crystal, 18: 25035 (UCRL-Trans-1055(L))

GULEL'MI (GUL'YEL'MI), A. V., Group velocity of slow waves in drifting magnetically active plasma, 18: 24777

GUMENYUK, Yu. P., Welding Nb, 18: 24108

GUNTER, E. J., Pressure distribution in gas-lubricated, tilting-pad, journal bearings, 18: 23747 (TID-7690(p.273-302))

GUNTER, Edgar J., Jr., Stability of flexible rotor subjected to rotary damping, 18: 23749 (TID-7690(p.313-30))

GUPTA, Ramdas P., ESR study of irradiated, oriented polypropylene, 18: 23679

GUPTA, V. S., Changes in physical properties of rocks in the vicinity of underground nuclear explosions, 18: 23786 (UCRL-13105)

GUREVICH, A. V., Recombination coefficient in dense low-temperature plasma, 18: 24801

GUZHAVIN, V. M., Production of π mesons in 650-Mev pp collisions, 18: 24476

GVOZDEV, B. A., Preparation of Th, U, and Pu oxide and rare earth coatings, 18: 23537

GVUZD', E., Extraction properties of Fm and Md, 18: 23725

GYOERGYI, G., Final state n–n interaction in three-particle photodisintegration of triton, 18: 24632

GYUK, I. P., Resonance poles for pion-baryon systems, 18: 24429

H

HAASE, D. J., Crystal chemistry of some rare earth–group VI compounds, 18: 23506

HAASE, G., Latent images in case of electron irradiation, 18: 23907

HACKER, H., Jr., Magnetic susceptibility of several rare earth oxides, 18: 23513

HAEBERLI, W., Production of beam of polarized H^- ions, 18: 24680

HAELG, W., Structure of peritectic Pr–Fe and Nd–Fe compounds, 18: 24184

HAEMERS, H., Electrolytical polishing application in metallography, 18: 24107 (SC-T-64-903)

HAERDI, W., Determination of elements by γ spectrometry after neutron activation, 18: 23422

HAGEN, Kenneth G., Integration of radiators with nuclear systems, 18: 23779

HAGGE, Donald E., Elastic scattering of π^+ by protons, 18: 24453

HAGGE, Donald E., Elastic scattering of π^- by protons, 18: 24454

HAGUE, J. R., Refractory ceramics of interest in aerospace structural applications, 18: 24141 (RTD-TDR-63-4102)

HAISSINSKY, M., Radiolytic reduction of KIO_3 in alkaline medium, 18: 23674

HALBERT, M. L., Angular-momentum effects in compound-nucleus reactions, 18: 24726

HALE, R. M., High-temperature tensile properties of ZTA grade graphite, 18: 24145 (WADD-TR-61-72(Vol.XIV))

HALL, Eric J., Survival of HeLa cells exposed to protracted γ irradiation, 18: 23280

HALL, Laurence S., Oscillations in a uniform magnetized plasma, 18: 24787

HALL, W. F., Decomposition pressure of B_4C and heat of sublimation of B, 18: 23479

HALLISEY, Robert M., Strontium-90 content of human bones 1961-63, 18: 23833

HALLIWELL, James, Improvements in or relating to welding, 18: 24113

HALPERN, Aleksander, Electrical conductivity of Al(III), Ga(III) and In(III) iodides in alkyl iodides, 18: 23449 (PAN-491/V)

HAM, W. T., Jr., Light source for production of retinal burns, 18: 23254

HAMADA, Hakuo, Radiation-induced polymerization of unsaturated 5-membered ring compounds, 18: 23597 (AEC-tr-6316(p.154-62))

HAMILTON, C. B., Treatment of Cs ore, 18: 24991 (IS-884)

HAMILTON, D. C., Superconducting metastable compounds, 18: 24142 (TID-20617)

HAMILTON, J. H., Internal conversion studies in decay of Ag-110m, 18: 24738

HAMMER, C. L., High-frequency limit of bremsstrahlung spectrum, 18: 24426

HAN, Cheng, Protective effect of streptomycin against radiation damage in mammals, 18: 23359 (JPRS-24593(p.120-5))

HANKS, Charles W., Electron beam furnace, 18: 23758

HANNA, M. G., Jr., Spleen white pulp germinal centers during primary immune response, 18: 24998 (ORNL-3595)

HANSEN, Paul-Ivar E., Irradiation of meat products, 18: 23272

HANSEN, Spenst M., Crater nomenclature, 18: 25018 (UCRL-7750)

HANSON, Wayne C., Radioactivity measurements in Alaskan Eskimos in 1963, 18: 23834

HANTABAL, E., Separating elements of alkaline earth group on ion exchangers, 18: 23421

HAOT, J., Effect of cortisone on gastric lesions produced by irradiation, 18: 23267

HARADA, Yoshihiro, Release of saline-soluble DNA and change in spleen after x irradiation, 18: 23257

HARARI, H., Processes forbidden by the G_2 symmetry, 18: 24441

HARBAUGH, W. E., Prog. rpt. on thermionic converter for nuclear applications, 10/9/62–9/30/63, 18: 24369 (NP-13892)

HARDING, L. K., Radiosensitivity of male primordial germ cells and spermatogonia, 18: 23331

HARDY, Lynn, Heat transfer of rod matrices, 18: 23764 (APEX-724)

HARGREAVES, G., Changes in polyamide and elastomeric polymers due to nuclear, ultraviolet, and thermal radiation, 18: 23579 (NP-13825)

HARKER, Howard R., Electron beam furnace, 18: 23758

HARKER, Yale D., Etching effects during processing, 18: 23928

HARLOW, R. A., ESADA fuel fabrication, 18: 23404 (AI-8700(Vol.V))

HARP, R. S., Behavior of resonance probe in plasma, 18: 24771

HARRINGTON, F. E., Zr–U processing equipment contamination and decontamination, 18: 23705 (ORNL-TM-837)

HARRIS, D. R., Place of materials testing reactors, 18: 24973

HARRIS, G. I., Polarization of γ rays from $Si^{30}(p,\gamma)P^{31}$, 18: 24662

HARRIS, S. M., Depolarization of fast positrons by bremsstrahlung, 18: 24435

HARRISON, R. C., LCRE neutron sensor, 18: 23888 (PWAC-424)

HART, E. J., Ultraviolet spectra of transients produced in radiolysis of aqueous solutions, 18: 23683

HARTER, Franz C., Prog. rpt. on thermionic generator, 1–3/64, 18: 2437 (PWA-2337)

HARTNELL-BEAVIS, Michael Carl, Fuel elements, 18: 24872
HARVEY, B. G., Scattering of 65-Mev He ions from O-16, 18: 24623 (UCRL-10727)
HARVEY, E. B., Effects of ionizing irradiation of gametes and zygotes on embryonic development, 18: 23327
HARWOOD, Jonathan H., III, Renal function in Nb-poisoned rats, 18: 23203 (UR-646)
HASEGAWA, A. T., Sodium nitrite in radioprotection in mice, 18: 23356 (NP-13918(p.99-106))
HATA, Kazuto, Emission characteristics of ZnS phosphors, 18: 23693
HATADA, Motoyoshi, Beta-induced exchange of O atoms between CO_2 molecules, 18: 23609 (AEC-tr-6316(p.238-44))
HATADA, Motoyoshi, Electrolytic dissociation of aliphatic amines by β bombardment, 18: 23608 (AEC-tr-6316(p.232-7))
HATADA, Motoyoshi, Gamma-induced synthesis of tertiary alcohols, 18: 23612 (AEC-tr-6316(p.261-5))
HATADA, Motoyoshi, Ketone synthesis by radiation-induced reaction, 18: 23610 (AEC-tr-6316(p.245-52))
HATADA, Motoyoshi, Moisture determination of cellulose fiber using O-18, 18: 23397 (AEC-tr-6316(p.274-82))
HATADA, Motoyoshi, Radiation-induced reaction between acetaldehyde and ethylene, 18: 23611 (AEC-tr-6316(p.253-60))
HATAYAMA, Noriyuki, Gamma-induced graft polymerization of styrene, 18: 23585 (AEC-tr-6316(p.84-8))
HATSOPOULOS, George N., Nuclear thermionic power systems, 18: 24927
HAVENS, W. W., Jr., Neutron resonance spectroscopy. III., 18: 24673
HAYASHI, Koichiro, Electrical properties of polyacrylonitrile-formed radiation-induced polymerization, 18: 24149 (AEC-tr-6316(p.226-31))
HAYASHI, Koichiro, Graft polymerization of polyoxymethylene induced by radiation, 18: 23607 (AEC-tr-6316(p.223-5))
HAYASHI, Koichiro, Radiation-induced liquid-phase anionic polymerization, 18: 23591 (AEC-tr-6316(p.129-30))
HAYASHI, Koichiro, Radiation-induced polymerization of vinyl ether, 18: 23592 (AEC-tr-6316(p.131-3))
HAYASHI, Koichiro, Radiation-induced polymerization of vinyl acetate, 18: 23593 (AEC-tr-6316(p.134-6))
HAYASHI, Koichiro, Radiation-induced polymerization on γ alumina, 18: 23594 (AEC-tr-6316(p.137-44))
HAYASHI, Koichiro, Radiation-induced polymerization of acrylonitrile, 18: 23595 (AEC-tr-6316(p.145-51))
HAYASHI, Koichiro, Radiation-induced polymerization of compounds with triple bonds, 18: 23596 (AEC-tr-6316(p.152-3))
HAYASHI, Koichiro, Radiation-induced polymerization of unsaturated 5-membered ring compounds, 18: 23597 (AEC-tr-6316(p.154-62))
HAYASHI, Koichiro, Radiation-induced polymerization of formaldehyde, 18: 23598 (AEC-tr-6316(p.163-7))
HAYASHI, Koichiro, Radiation-induced polymerization of fomaldehyde, 18: 23599 (AEC-tr-6316(p.168-73))
HAYASHI, Koichiro, Radiation-induced polymerization of glyoxal, 18: 23600 (AEC-tr-6316(p.174-7))
HAYASHI, Koichiro, Radiation-induced polymerization of acetone types, 18: 23601 (AEC-tr-6316(p.178-81))
HAYASHI, Koichiro, Radiation-induced polymerization of trioxane, 18: 23602 (AEC-tr-6316(p.182-5))
HAYASHI, Koichiro, Radiation-induced polymerization of diketene, 18: 23603 (AEC-tr-6316(p.186-9))
HAYASHI, Koichiro, Radiation-induced polymerization of β-propiolactone, 18: 23604 (AEC-tr-6316(p.190-4))
HAYASHI, Koichiro, Radiation-induced polymerization of mixed crystals, 18: 23605 (AEC-tr-6316(p.201-7))
HAYASHI, Koichiro, Radiation-induced polymerization by ring cleavage, 18: 23606 (AEC-tr-6316(p.208-11))
HAYASHI, Koichiro, Structure of polymers formed by radiation-induced ring cleavage, 18: 24148 (AEC-tr-6316(p.212-16))
HAYASHI, Shigenori, Transient heat transfer in heterogeneous water reactor. II., 18: 23776
HAYDEN, G. A., Effects of γ radiation on ribonuclease, 18: 23295
HAYMAN, P. J., Primary and sea-level spectra of cosmic rays, 18: 24340
HAYON E., Dependence of yields upon pH and solute concentration in γ irradiation of H_2O, 18: 23681
HEATH, R. L., Prog. rpt. on gamma spectrometry, annual, 3/27/64, 18: 24585 (IDO-16969)
HECHT, F., Enrichment of U on peat, 18: 23806
HECKMAN, Harry H., Mirroring protons in South Atlantic anomaly, 18: 24515 (UCRL-11409)
HECKMAN, Harry H., Track measurements with digitized microscope, 18: 23940
HECKMAN, Harry H., Video track analysis, 18: 23939
HECKROTTE, Warren, Oscillations in a uniform magnetized plasma, 18: 24787
HEDGCOCK, F. T., Role of s-d exchange interactions in dilute alloys, 18: 24555
HEESTAND, J., ARGUS—program for calculating transient temperatures, 18: 23763 (ANL-6654)
HEGGE, J. I., Re-entry flight demonstration number one, 18: 24941 (SC-RR-64-501)
HEIDELBERG, R. F., Rare earth–Po-210 systems, 18: 24127 (CONF-405-33)
HEIMANN, G., Particle photography. IV., 18: 23904
HEIMANN, G., Swelling measurements in development of emulsions, 18: 23555
HEIMBURGER, Robert, Preparation and study of uranyl and U(IV) salts, 18: 23473
HEIN, R. A., BeO phase transformation, 18: 24163
HEINIGER, F., Bulk superconductivity in dilute hexagonal Ti alloys, 18: 24553
HEINZER, P., Distortion and spurious scattering, 18: 23951
HEINZER, P., Influence of development factors on parasitic scattering, 18: 23935
HELA, Ilmo, Concentration factors for radioactive substances in aquatic organisms, 18: 23172
Helena Mariano, Maria
see Mariano, Maria Helena
HELLAND, Jerome A., Elastic scattering of π^+ by protons, 18: 24453
HELLAND, Jerome A., Elastic scattering of π^- by protons, 18: 24454
HELLER, Carl G., Rate of spermatogenesis in man, 18: 23176
HELLER, S., STEAM—program to analyze spark chamber data, 18: 23872 (BNL-833)
HELMKAMP, Ralph W., Determination of total I in I-131-iodide preparations, 18: 23413 (UR-644)
HENDERSON, C. M., Prog. rpt. on high-temperature thermoelectric research, 9–12/63, 18: 24351 (AD-427285)
HENDERSON, R. E., Liquid metal cells, 18: 24354 (ANL-6802(p.49-52))
HENDRICKS, Charles D., Charged-particle propulsion, 18: 24358 (ANL-6802(p.89-99))
HENDRICKS, Jean, Conditioned aversion to saccharin using x rays as unconditioned stimulus, 18: 23239 (FSU-2690-15(Paper 5))
HENDRICKS, Jean, Conditioned aversion to saccharin during post exposure period, 18: 23240 (FSU-2690-15(Paper 7))
HENDRIE, D. L., Location in 4^- in level in Zr-90, 18: 24661
HENNECKE, H. J., Polarization of γ rays from $Si^{28}(p,\gamma)P^{29}$, 18: 24662
HENNIG, G., Field emission from crystals of graphite, 18: 24121 (ANL-6804)
HENRI, V. P., Production mechanism for reaction $K^+p \rightarrow K^*p$ at 3 Bev/c, 18: 24449
HENRY, A. F., WIGLE program for solution of two-group space-time diffusion equations in slab geometry, 18: 24572 (WAPD-TM-416)
HENRY, David L., Radiation damage of LiH, 18: 24188 (APEX-329)
HENRY, Philippe, Measuring U in biological media, 18: 23405 (CEA-R-2415)
HENRY, Warren E., High-field magnetization of rare earth metals and alloys, 18: 24186
HENSON, R. W., Scattering of long wavelength neutrons in graphite, 18: 24207
HERCZYNSKA, Elwira, Adsorption of H^+ and OH^- ions on Ni and Al, 18: 23448 (PAN-466/V)
HERRON, David P., How toll enrichment will reduce fuel costs, 18: 24866
HERSIL, I., Properties of EAS at 4200 meters, 18: 24343
HERSKIND, B., Coulomb excitation of vibrational states in deformed nuclei, 18: 24729
HESS, D. N., Kinetics of thermal decomposition of biphenyl, 18: 23570 (ORNL-3602)
HESSE, Gerhard, Chromatographic procedures in organic chemistry, 18: 25032 (SC-T-64-618)

HESSEL, Darryl L., Radiation effects on chick embryos, 18: 23229 (ANL-6823(p.5-14))
HESSLER, K., Electric mobility of $^{42}K^+$ in aqueous KNO_3 solutions, 18: 23467
HEYMAN, G., Relative size of Ca-44 and Ca-40, 18: 24583 (CONF-502-4)
HICKS, L. D., ESADA fuel fabrication, 18: 23404 (AI-8700(Vol.V))
HIEBERT, John C., Scattering of 168-Mev O-16 nuclei from C-12, 18: 24709
HIETBRINK, Bernard E., Influence of x irradiation on thiophosphate-oxidizing enzyme system in livers, 18: 23241 (NP-13918(p.13-27))
HIETBRINK, Bernard E., Radiation effects on biochemistry of tissues. I., 18: 23202 (NP-13918(p.1-12))
HIGASHI, S., High-energy muon flux at sea level, 18: 24336
HIGASHIMURA, Takenobu, Low-energy spectrum of β radiation, 18: 24628 (AEC-tr-6316(p.59-65))
HILDENBRAND, D. L., Decomposition pressure of B_4C and heat of sublimation of B, 18: 23479
HILL, Julie, Tritium–H exchange in keratins, 18: 23211
HILL, R. D., Absorption of π^- in light nuclei, 18: 24582 (AD-439331)
HILLAIRET, J., Resistivity measurements using d-c induction method, 18: 23837 (CEA-R-2402)
HILLAIRET, J., Survey of E.D.F. 4, 18: 24920
HILLMAN, P., Use of internal beam of synchrotron for study of reaction (e,e'p), 18: 24243 (ISS-63/42)
HINDE, A., Biology of Solway Firth. XII., 18: 23180 (PG-Report-578)
HINES, K. C., Neutron slowing-down spectra in Be and BeO, 18: 24576
HINKLE, J. G., Pressure distribution in gas-lubricated, tilting-pad, journal bearings, 18: 23747 (TID-7690(p.273-302))
HIRANO, Shizo, Quantitative analysis utilizing isotopic exchange reaction, 18: 23430
HIRAOKA, Eiichi, Discharge figures in dielectrics by electron irradiation. II., 18: 24203
HIRAOKA, Eiichi, Response of ionization chamber in pulsed beam, 18: 23897
HIRAOKA, Masahiko, Radiation-induced polymerization of acrylonitrile, 18: 23639 (AEC-tr-6316(p.465-8))
HIRAOKA, Tsuichi, Beta dosimetry by discoloration of PVC film, 18: 23894 (AEC-tr-6316(p.46-58))
HIRATA, Masashi, Exposure dose by diagnostic x ray in obstetrics, 18: 23831
HIROTA, Kozo, Beta-induced exchange of O atoms between CO_2 molecules, 18: 23609 (AEC-tr-6316(p.238-44))
HIROTA, Kozo, Electrolytic dissociation of aliphatic amines by β bombardment, 18: 23608 (AEC-tr-6316(p.232-7))
HIROTA, Kozo, Graft polymerization of polyethylene pre-irradiated in air, 18: 23613 (AEC-tr-6316(p.266-73))
HIROTA, Kozo, Ketone synthesis by radiation-induced reaction, 18: 23610 (AEC-tr-6316(p.245-52))
HIROTA, Kozo, Moisture determination of cellulose fiber using O-18, 18: 23397 (AEC-tr-6316(p.274-82))
HIROTA, Kozo, Radiation-induced reaction between acetaldehyde and ethylene, 18: 23611 (AEC-tr-6316(p.253-60))
HIRSH, M. N., Prog. rpt. on radiation effects on EM signals in air, 10–12/63, 18: 24300 (NP-13953)
HLADYSHEVSKII, E. I., Crystal structure of $EuGe_2$, 18: 24156
HO, C., Fuel loading for Elk River second core, 18: 24875 (ACNP-64536)
HOAGLAND, R. G., Effects of neutron irradiation on Zy-2, 18: 24191 (HW-SA-3194)
HOAGLAND, R. G., Effects of temperature and irradiation on austenitic stainless steels, 18: 24192 (HW-SA-3221)
HOARD, J. L., Complexes of La and other rare earth (III) ions, 18: 23518
HOCH, M., Field emission from crystals of graphite, 18: 24121 (ANL-6804)
HOCH, Michael, Non-stoichionetry in CeO_{2-x}, 18: 23516
HOCH, Michael, Specific heat and emissivity of Ta, 18: 24122 (ASD-TDR-63-371)
HOCKENBURY, R. W., Fission cross section of Pu-241, 18: 24586 (IDO-16976)
HODGES, James C., Video track analysis, 18: 23939
HOFFMAN, C. J., Chemical and physical properties of SmC_2, 18: 23517
HOFFMANN, K.-U., Free path length in air plasma, 18: 24773
HOFMANN, A., Production investigations for 14-Mev neutrons from $^3H(d,n)^4He$, 18: 24604 (NP-13930(p.54-5))
HOGG, B. G., Mass effect corresponding to nuclear deformation in region N ~ 90, 18: 24681
HOLDEN, F. C., Refractory ceramics of interest in aerospace structural applications, 18: 24141 (RTD-TDR-63-4102)
HOLDEN, R. B., Prog. rpt. on thermodynamics of U–N system, annual, 1/64, 18: 23454 (UNC-5077)
HOLLADAY, R. L., Prog. rpt. on high-power-density development, 10–12/63, 18: 24885 (GEAP-4488)
HOLLAND, M. W., Study of nonmesic hyperfragments with $Z \geq 3$, 18: 24654
HOLLANDSWORTH, C. E., Precision accelerator voltage measurements, 18: 24242 (CONF-22-33)
HOLLISTER, H., Target reloading in neutron generators, 18: 24579
HOLMES, R., Vibrational de-excitation of O in heteromolecular collisions, 18: 24315
HOLSOPPLE, H. L., Synthesis and infrared absorption of N,N',N''-trimethylborazine, 18: 23571 (ORNL-TM-860)
HOLT, L. A., Tritium–H exchange in keratins, 18: 23211
HONIG, J. M., Phase transition region of $PrO_{1.8}$, 18: 23504
HOOD, R. R., Prog. rpt. on D_2O-moderated power reactors, 3–4/64, 18: 24882 (DP-905)
HOOGLAND, W., Measurements on short-range hyperfragments, 18: 24445
HOP-AREVYAN, N. G., Effects of x rays on horse bean plantules, 18: 23299
HOPKINS, B. J., Gross developmental anomalies induced by Sr-90 in rat embryo, 18: 23244 (UR-643)
HOPKINS, B. J., Retention of Sr-90 in rats, 18: 23243 (UR-642)
HOPKINS, Harry P., Entropies of aqueous Li and fluoride ions, 18: 23515
HOPWOOD, M. L., Effect of testicular x irradiation on bull semen, 18: 23337
HORI, Shiro, Gamma irradiation of onion bulbs, 18: 23255
HORI, Yasuharu, Radiation-induced leukemia in mice. I., 18: 23256
HORIKAWA, M., Reactivation of x-irradiated mouse L cells, 18: 23367
HIROTA, Kozo, Gamma-induced synthesis of tertiary alcohols, 18: 23612 (AEC-tr-6316(p.261-5))
HORSLER, A. F. C., Cesium-137 sources for radiotherapy, 18: 23389
HORTIG, G., Gamma-ray studies of B-11, N-14, and F-19 induced transfer reactions, 18: 24721
HOSHINO, Shigeo, Formation of radiation-induced graft polymers, 18: 236 (AEC-tr-6316(p.672-5))
HOSHINO, Shigeo, Graft polymerization of vinyl monomers, 18: 23657 (AEC-tr-6316(p.640-9))
HOSHINO, Shigeo, Radiation-induced polymerization of acrolein diethyl ether, 18: 23641 (AEC-tr-6316(p.471-80))
HOSHINO, Shigeo, Radiation-induced oxidation of phenyl cyclohexane, 18: 23656 (AEC-tr-6316(p.623-39))
HOSHINO, Shigeo, Radiation-induced graft polymerization on cellulose, 18: 23658 (AEC-tr-6316(p.650-9))
HOUSE, R. D., Prog. rpt. on emissivity of materials, final, 7/59–12/62, 18: 24138 (PWA-2206(Vol.I))
HOVI, Veeineo, Quadrupole splitting in NMR of Na-23 in $NaClO_3$, 18: 2346
HOWARD, Robert C., Nuclear thermionic power systems, 18: 24927
HOWE, Patrick W., Remote pipetters for hot-cell enclosures, 18: 23842 (UCRL-9661)
HOWELL, W. D., Micrologic elements in nuclear instrumentation, 18: 23850
HOWERTON, R. J., Structure in energy dependence of $\bar{\nu}$, 18: 24640
HOYLE, F., Relativistic astrophysics, 18: 24277
HRASKO, P., Final state n–n interaction in three-particle photodisintegration of triton, 18: 24632
HSIEN, Ting-chang, Possibility of hypernuclei of large strangeness, 18: 24448
HUANG, Hsi-huei, Absorption spectrum of Ce^{3+} in silica and borax glass, 18: 23459 (JPRS-24593(p.37-41))
HUBBARD, J. R., Decay rate prediction for $2\Xi^-$, 18: 24446
HUBERT, Pierre, First CAPEL experiment, 18: 24747 (CEA-R-2417)
HUGGINS, Charles, Cancer induced by single doses of irradiation or aromatic hydrocarbons, 18: 23349
HUGHES, Gillian C., Radiosensitivity of male primordial germ cells and spermatogonia, 18: 23331
HUGHES, John Wilfred, Stabilizing devices for bodies located in a channel or bore, 18: 24870
HUGHES, K. J., Nature of the chemisorbed acetate on PrO_2, 18: 23514

HUGHES, Thomas Picton, Coating surface with irradiated polymerizable material, 18: 23400
HUGON, J., Cells of duodenum of mouse after x irradiation, 18: 23266
HUGOT, Ch., Transistorized magnetic-tape recording and reading unit, 18: 23853
HUMMEL, H. H., ELMOE—program treating elastic scattering in reactors, 18: 24811 (ANL-6805)
HUMMEL, Rolf E., Influence of heat treatment and neutron irradiation on Au–Mn alloys, 18: 24210
HUNT, C., Buckling and reaction rates in Pu–graphite assemblies, 18: 24852
HUQUE, Heshamul, Controlling Bruchidae by γ rays, 18: 23270
HURLEY, J. P., Automated fast coincidence nuclear radiation spectrometer, 18: 23892 (USNRDL-TR-729)
HURST, G. S., Capture of low-energy electrons in chlorobenzene and bromobenzene, 18: 23686
HUSSAIN, M., Nuclear reaction studies with Li ions on B-10 and B-11 targets, 18: 24720
HWA, Rudolph C., Analytic structure of production amplitudes, 18: 24455
HYAMS, B. D., Forward production of photons from 9-Bev π-p interactions, 18: 24417
HYDE, Bruce G., Phase reactions in TbO_x–O_2 and related systems, 18: 23505

I

ICHINO, Motonobu, Radiation-induced polymerization of acrolein diethyl ether, 18: 23641 (AEC-tr-6316(p.471-80))
ICHINO, Motonobu, Radiation-induced graft polymerization on cellulose, 18: 23658 (AEC-tr-6316(p.650-9))
ICHIYE, Takeshi, Dye diffusion experiment off Long Island, 18: 25013 (TID-20612)
IGARASHI, Shoichi, Effect of radiation on thermal stability of polyethylene, 18: 23673
IHNO, Y., Deformities possibly due to thalidomide, 18: 25010 (TID-19257)
IIZUKA, Nobuji, Ketone synthesis by radiation-induced reaction, 18: 23610 (AEC-tr-6316(p.245-52))
IKEDA, Masamichi, Emission characteristics of ZnS phosphors, 18: 23693
IKEDA, Yoichi, ESR spectra of irradiated polymers, 18: 23617 (AEC-tr-6316(p.310-13))
IKEDA, Yoichi, Radicals formed by irradiation of polyethylene and polypropylene, 18: 23615 (AEC-tr-6316(p.295-305))
IKEDA, Yoichi, Radical production curve of irradiated polymers, 18: 23618 (AEC-tr-6316(p.314-21))
IKEDA, Yoichi, Singlet ESR spectra when polymers are exposed to high radiation flux, 18: 23616 (AEC-tr-6316(p.306-9))
ILENKOV, A. I., Measurement of short lifetimes of current carriers in semiconductor devices, 18: 23756
ILIN, R. N., Dissociation of H_2^+ ions in collision with atoms and molecules, 18: 24324
IL'INA, G. V., Disruption of plant metabolism caused by treating seeds with radioactive substances, 18: 23205(JPRS-24290(p.36-42))
IL'MENKOVA, L. I., Solvent extraction of Pa from aqueous solutions, 18: 23720
IMAIZUMI, M., Elastic scattering of 55-Mev protons by heavy nuclei, 18: 24665
INGERSOLL, Jean M., Environment resulting from nuclear wars. II., App. 1-2, 18: 23179 (HI-303-RR/A1-2)
INGLIS, D. R., Interference concepts in scattering and stripping, 18: 24713
INGRAHAM, R. L., Consequences of fundamental length in very-high-energy scattering, 18: 24436
IOKHEL'SON, S. V., Radiochemical determination of Sb-125 in soils, 18: 23431
IPPOLITOVA, E. A., Conditions for formation of modifications of UO_2, 18: 23475
IRVIN, J. E., Effects of temperature and irradiation on austenitic stainless steels, 18: 24192 (HW-SA-3221)
ISBEN, Kenneth H., Effect of tetracycline on retention of Ca and Sr in rodents, 18: 23220
ISHIGURE, Kenkichi, Copolymerization of tetrafluoroethylene with isobutene induced by radiation, 18: 23685
ISHITSUKA, Mutsumi, Measurement of H-alpha flare spectrograms, 18: 24271 (NP-13803)
ISHITSUKA, Mutsumi, Observations of solar flares and solar activity, 18: 24269 (NP-13801)
ISHIYAMA, Toshio, Decontamination of radioactive waste water, 18: 24981
ISHIYAMA, Toshio, Decontamination of radioactive Ru, 18: 24983
ISHIYAMA, Toshio, Dewatering property of radioactive sludge concentrator, 18: 24984
ISHIYAMA, Toshio, Humic acid as coagulation agent for Ca phosphate flocculation, 18: 24982
ISMAILZADE, I. G., High-temperature phase transitions in $NaNbO_3$–$NaTaO_3$, 18: 24162
ISRAELI, Julius, Ultraviolet spectrum of XeF_4, 18: 23469
ISRAELI, Julius, Ultraviolet spectrum of XeF_2, 18: 23468
ISTOMIN, E. I., Welding Nb, 18: 24108
ITO, Rinsuke, Backscattering of electrons in range 4 to 14 Mev, 18: 24409
ITO, Rinsuke, Secondary electron monitor for energies below 20 Mev. II., 18: 24253
ITZYKSON, C., High-energy lepton-nucleon scattering, 18: 24419
IVANOV, K. G., Local increase of ionosphere conductivity, 18: 24527
IVANOV, V. I., Effect of small bursts in cosmic-ray hard component, 18: 24334
IVENSEN, V. A., Structure of two-phase metal-powder solid alloys, 18: 24175
IWAZUMI, Tetsuo, Transient heat transfer in heterogeneous water reactor. II., 18: 23776
IZERGINA, A. G., Effects of unithiol on excretion of chemical compounds in urine of rats injured by Po-210, 18: 23382
IZJUMOV, Ju. A., Electron theory of transition metals, 18: 24305
IZURA, Harumi, Beta dosimetry by discoloration of PVC film, 18: 23894 (AEC-tr-6316(p.46-58))
IZURA, Harumi, Calorimetric determination of β flux, 18: 23893 (AEC-tr-6316(p.24-30))
IZURA, Harumi, Distribution of β energy dissipation in absorbers. I., 18: 24626 (AEC-tr-6316(p.35-41))
IZURA, Harumi, Distribution of β energy dissipation in absorbers. II., 18: 24627 (AEC-tr-6316(p.42-5))
IZURA, Harumi, Gamma absorption adjacent to scattering bodies. I., 18: 24217 (AEC-tr-6316(p.9-16))
IZURA, Harumi, Low-energy spectrum of β radiation, 18: 24628 (AEC-tr-6316(p.59-65))

J

JABBUR, R. J., Depolarization of fast positrons by bremsstrahlung, 18: 24435
JACKSON, R. F., Place of materials testing reactor, 18: 24973
JACKSON, W. J., MHD power generation, 18: 24359 (ANL-6802(p.101-9))
JACOB, M., High-energy lepton-nucleon scattering, 18: 24419
JACOBS, J., Re-entry flight demonstration number one, 18: 24941 (SC-RR-64-501)
JACOBSON, John R., Neutron-flux and γ-dose measurements at AFRRI reactor, 18: 24957 (NDL-TR-59)
JACOBSON, L., Plasma measurements on IPM-A, 18: 24749 (CONF-521-2)
JACOBSON, L. A., Stabilization of cubic zirconia, 18: 23503
JAENECKE, J., Reaction $Ti^{48}(p,n)V^{48}$, 18: 24612 (NP-13930(p.134))
JAHN, Helmut, Statistics of nuclear level intervals and widths, 18: 24598 (NP-13930(p.17-25))
JAHREN, G. A., Advanced test reactor fuel plate pressure deflection tests, 18: 24963 (TID-20621)
JAIN, B. D., Studies of U(VI) complex with 3-phenyldaphnetin, 18: 23429
JAIN, G. C., Contact resistance of Fe-plated Pb telluride contact, 18: 24357 (ANL-6802(p.78-86))
JAIN, P. C., Lifetimes of charged Σ hyperons, 18: 24415
JAIN, Samar Chand, Coordination complexes of group(IV) halides, 18: 23471
JAMES, B. T., Control of H-3 in D_2O in DIDO-class reactors, 18: 23812 (AERE-R-4528(p.35-47))
JAMES, B. T., Health physics control of research reactors, 18: 23809 (AERE-R-4528)
JANA, Manas K., X-ray-induced mutations of *Phaseolus mungo*. I., 18: 23263

JANES, G. S., Use of guard ring shields on negatively biased Langmuir ion collection current probes, 18: 24756 (NP-13946)
JANSSEN, E., Prog. rpt. on two-phase pressure losses, 8/12–11/11/63, 18: 23766 (GEAP-4431)
JANZ, George J., Non-aqueous AgNO$_3$ solutions: electrical conductance, 18: 25000 (RPI-1999-3)
JASSELETTE, P., Remarks on generators of the SU3 group, 18: 24422
JENSEN, N. L., Chemical and physical properties of SmC$_2$, 18: 23517
JINKINS, Patricia B., Parameters of radiation dosage that influence osteogenic sarcomas, 18: 23231 (ANL-6823(p.20-43))
JODRA, L. G., Coefficients of diffusion in UO$_2$SO$_4$–anion exchange resin systems, 18: 23710
JOHNSON, C. E., Hydride and bimetallic regenerative EMF cells, 18: 24355 (ANL-6802(p. 53-63))
JOHNSON, Gordon C., Interstitial time-dose corrections, 18: 23396
JOHNSON, Irving, Decomposition pressure of TcZn$_6$, 18: 23488
JOHNSON, Noye M., Dosimetry for intracavitary Ra applicators, 18: 23395
JOHNSON, William, Making impermeable composite carbon tube, 18: 24117
JOHNSTON, I. D. S., Production of highly excited neutral atoms for injection into plasma devices. I., 18: 24757 (NP-13948)
JONES, C. M., Scattering (n,d) and search for dineutron effects, 18: 24444
JONES, D. W., Hydrogen affinity of b.c.c. Mo–Re alloys, 18: 24165
JONES, David C. L., Effect of age at irradiation on rat life span, 18: 23292
JONES, E. A., Radiosensitivity of male primordial germ cells and spermatogonia, 18: 23331
JONES, Herbert Noel, Fabrication of reactor fuel elements, 18: 24116
JONES, J. C., Cesium-137 sources for radiotherapy, 18: 23389
JONES, Robert E., Constant-velocity traveling magnetic wave plasma engine, 18: 24754 (NASA-TN-D-2278)
JONES, Stanley B., Neutron slowing down and absorption logging method, 18: 23868
JONES, W. B., Scattering of 65-Mev He ions from O-16, 18: 24623 (UCRL-10727)
JONGEJANS, B., Production mechanism for reaction K$^+$p → K$^+$p at 3 Bev/c, 18: 24449
JOOS, P., Polarization of Λ^0 from γ + p = K$^+$ + Λ^0, 18: 24428
JORDAN, Dean L., Fractionated irradiation of mice, 18: 23230 (ANL-6823(p.15-19))
JORDAN, Duane P., Computer analysis of fluid flow involving real gases, 18: 23772 (UCRL-7530)
JORDAN, T. F., Relativistically invariant position operators for spinning particles, 18: 24401 (NYO-10270)
JOSEPH, C., Angular distribution inelastic diffusion of neutrons in C, 18: 24603 (NP-13930(p.51-3))
JOUKHNOVSKAYA, O. P., Chemical ripening of R emulsion, 18: 23497
JOVE, J., Radiolytic reduction of KIO$_4$ in alkaline medium, 18: 23674
JULLIEN, G., CABRI—experimental swimming pool reactor, 18: 24969

K

KABIR, P. K., Development of weak interaction theory, 18: 24514
KACZMARCZYK, Alexander, Polarizability of closed-cage B$_{10}$H$_{10}^{2-}$, 18: 23487
KADYSH, I. Ya., Skin effect in high-frequency ring discharge, 18: 24800
KAEGI, Jakob, Steam-cooled nuclear power plant, 18: 24930
KAHN, Peter B., Higher-order spacing distributions for a class of unitary ensembles, 18: 24679
KAISER, B., Action of ion beams on nuclear emulsions, 18: 23916
KALABUKHOVA, T. N., Effects of monomers on γ-irradiated erythrocytes, 18: 23381
KALACHNIKOVA, V. I., Structure and size of centers in R emulsion, 18: 23913
KALBFLEISCH, G. R., Decay rate prediction for 2Ξ$^-$, 18: 24446
KALINKINA, T. A., Improvements for emulsions by incorporation of surface-active material, 18: 23495
KALLIO, A., Separation method in shell-model calculation, 18: 24649
KALYAMIN, A. V., Separation of Au and Tl from a complex mixture by partition chromatography, 18: 23732
KAMBE, Hirotaro, Effect of radiation on thermal stability of polyethylene, 18: 23673
KAMEFUCHI, S., Self-consistent method of quantum field theory, 18: 24437
KAMEMOTO, Yoichiro, Reactivation analysis of Hg, 18: 23425
KAMENETSKII, A. B., High-thermal resistance of products manufactured from ZrO$_2$, 18: 24111
KAMIEN'SKI, Erwin, Control rods with sintered boron carbide, 18: 24974
KAMITSUBO, H., Elastic scattering of 55-Mev protons by heavy nuclei, 18: 24665
KAMIYA, Y., Primary and sea-level spectra of cosmic rays, 18: 24340
KAMMURI, Tetsuo, Distorted wave analysis of nuclear transfer reactions, 18: 24719
KANAZAWA, Tamotsu, Measurement of short-lived isotope, 18: 24637
KANE, R. P., Energy spectrum of daily variation of cosmic-ray intensity, 18: 24338
KANEKO, Shobu, Vibrational transition in molecular collision. V., 18: 24320
KANICHEVA, I. R., Penetrability of electrons through Al foils, 18: 24317
KANTER, H., Backscattering of kilovolt electrons from thin films, 18: 24304
KAPASI, K. B., Study of equatorial spread-F, 18: 24535
KAPLAN, Selig N., Collisional electron detachment from 20-Mev D^0 and D$^-$ ions, 18: 24310
KAPUSTINSKII, A. F., Solubility and thermodynamical properties of BaSO$_4$ and BaSeO$_4$, 18: 23457 (ANL-Trans-23)
KAPUSTSIK, E., Electromagnetic properties of baryons in unitary symmetry model, 18: 24388 (JINR-P-1616)
KARBENDAM, J., Liquid radioactive waste disposal at hospital, 18: 24965
KARKHANAVALA, M. D., Electrical conductivity and thermoelectric power of δ-U$_3$O$_8$. II., 18: 24120 (AEET/CD/21)
KARMASIN, M., Acceleration of α particles in cyclotron U-120, 18: 24260
KARNAUKHOV, V. A., Proton emitters among products of heavy-ion-induced reactions, 18: 24737
KARTUZHANSKII, A. L., Mechanism of sensitization of nuclear emulsions by dyestuffs, 18: 23499
KARTUZHANSKII, A. L., Photometric equivalent of blackening produced by light and radiation, 18: 23914
KARTUZHANSKII, A. L., Resolving power of photographic layers, 18: 23915
KARUPU, V. Ya., Effects of whole-body x irradiation on peripheral nerve system in liver, 18: 23309
KASHIWABARA, Kyuji, ESR of polycarbonates. I., 18: 23646 (AEC-tr-6316(p.522-5))
KASHIWABARA, Kyuji, ESR of irradiated polyethylene, 18: 23647 (AEC-tr-6316(p.526-33))
KASHKAROV, I. E., Effect of small bursts in cosmic-ray hard component, 18: 24334
KATIYAR, Sarvagya S., Detection of sub-micro quantities of Th, 18: 23424
KATSH, Seymour, Influence of gonadectomy, sex and strain upon survival times of x-irradiated mice, 18: 23347
KATZ, J. J., Potentiation of chemotherapy of tumors by D$_2$O, 18: 23209
KATZIN, Leonard I., Spectral evidence on rare-earth covalent binding, 18: 23438 (CONF-405-35)
KAUFMAN, D. F., Prog. rpt. on single-crystal deformation in zone-refined Be, 7/62–6/63, 18: 24134 (NMI-1257)
KAWABATA, Keisuke, Short pulsing for linac. II., 18: 24254
KAWAI, T., Resonance poles in the multi-channel scattering amplitudes, 18: 24432
KAWAI, T., Resonance poles in the scattering amplitudes with unstable particles, 18: 24433
KAWAISHI, Toru, Exposure dose by diagnostic x ray in obstetrics, 18: 23831
KAWASAKI, Toshio, Gamma irradiation of onion bulbs, 18: 23255
KAWASE, Shigeru, Radicals produced in irradiated cellulose, 18: 23588 (AEC-tr-6316(p.100-4))
KAZANSKII, Yu. A., Gamma rays from radiative capture of fast neutrons in Mn and Cu, 18: 24699
KAZARINOV, N. M., Angular and energy characteristics of fission-neutron emission of U-235, 18: 24697
KAZARINOV, Yu. M., Spin correlation coefficients in elastic 315-Mev scattering, 18: 24389 (JINR-P-1617)
KEENE, Arthur R., Radiological control experience with Pu fuels, 18: 23824 (HW-81363)
KEENE, J. P., Absorption spectrum and reaction constants of the hydrated electron, 18: 23691
KEENE, J. P., Pulse radiolysis of ferrous sulfate solution, 18: 23692

KELBG, G., Quantum statistics of gases with Coulomb interaction, 18: 24489

KELLEY, K. K., Thermodynamic data for NbC, 18: 23435 (BM-RI-6446)

KELLY, B. T., Elastic constants of polycrystalline carbons and graphites, 18: 23567

KELLY, Hugh P., Correlation effects in many-fermion systems. II., 18: 24461

KENDON, Martin Honess, Improvements in nuclear reactors, 18: 24831

KENDRICK, E. D., Fuel loading for Elk River second core, 18: 24875 (ACNP-64536)

KEOUGH, R. F., Metabolism of SNAP radionuclides in swine, 18: 23200 (HW-SA-3350)

KERN, Walter, Therapy of lethal radiation injury with nicotinic acid derivatives. I., 18: 23365

KERSHNER, C. J., Rare earth–Po-210 systems, 18: 24127 (CONF-405-33)

KERVINEN, J. A., Prog. rpt. on two-phase pressure losses, 8/12–11/11/63, 18: 23766 (GEAP-4431)

KESAREV, O. V., Separation of As and Ge phenyl derivatives by partition chromatography, 18: 23733

KESHMIRI, Marjorie, Influence of x irradiation on thiophosphate-oxidizing enzyme system in livers, 18: 23241 (NP-13918(p.13-27))

KESSEY, Kwadwo O., Rotating electrically conducting fluids in a long cylinder, 18: 24769

KHALKIN, V. A., Separation of Au from chloride solutions, 18: 23718

KHALOUPKA, P., Determination of the cosmic-ray equator, 18: 24329

KHAN, Mohammed Allahdad, Controlling Bruchidae by γ rays, 18: 23270

KHANIN, A. G., Changes in synapse of central nervous system during acute radiation sickness, 18: 23310

KHARADZE, G. A., Scattering of thermal neutrons by polarized nuclei, 18: 24580

KHASANOV, R. M., Cathodic sputtering of W by means of K ions, 18: 24776

KHERA, M. K., Directional distribution of cosmic-ray hard component, 18: 24337

KHODYREV, Yu. S., Skin effect in high-frequency ring discharge, 18: 24800

KHOSID, G. M., Preparation of Zr, 18: 24110

KHUTORETSKII, V. M., Reactivity of noble gases, 18: 23476

KHVATKOV, A. M., Linear electron accelerator up to 90 Mev, 18: 24245 (NP-13914)

KIKIANI, B. I., Dissociation of H_2^+ ions in collision with atoms and molecules, 18: 24324

KILMINSTER, David T., Neutron-flux and γ-dose measurements at AFRRI reactor, 18: 24957 (NDL-TR-59)

KIM, Khi In, Radiative resonance decays involving Λ hyperons, 18: 24387 (JINR-P-1615)

KIMBALL, D. S., Dynamics of the aurora. I., 18: 24538

KIMELDORF, Donald J., Effect of age at irradiation on rat life span, 18: 23292

KIMURA, Fujiko, Graft polymerization of styrene on pre-irradiated cellulose, 18: 23586 (AEC-tr-6316(p.89-94))

KIMURA, Fujiko, Radiation-induced graftings on cellulose, 18: 23587 (AEC-tr-6316(p.95-9))

KIMURA, Kiichi, Beta dosimetry by discoloration of PVC film, 18: 23894 (AEC-tr-6316(p.46-58))

KIMURA, Kiichi, Calorimetric determination of β flux, 18: 23893 (AEC-tr-6316(p.24-30))

KIMURA, Kiichi, Distribution of β energy dissipation in absorbers. I., 18: 24626 (AEC-tr-6316(p.35-41))

KIMURA, Kiichi, Distribution of β energy dissipation in absorbers. II., 18: 24627 (AEC-tr-6316(p.42-5))

KIMURA, Kiichi, Gamma absorption adjacent to scattering bodies. I., 18: 24217 (AEC-tr-6316(p.9-16))

KING, D. C., Graphical representation of data in Aldermaston and Winfrith nuclear data library, 18: 24987 (AEEW-M-426)

KINGSTON, A. E., Recombination and energy balance in decaying plasma. I., 18: 24793

KINGSTON, A. E., Recombination and energy balance in decaying plasma. II., 18: 24794

KINOSHITA, Florence, Influence of steroids on radiation-sensitive detoxification systems, 18: 23352 (NP-13918(p.28-41))

KIRILLOV-UGRYUMOV, V. G., Absorption of slowed-down π^- mesons in propane, 18: 24475

KIRIN, I. S., Composition of Sb(V) phenyl derivatives during β decay of Sb-125, 18: 23694

KIRIN, I. S., Synthesis of tri-α-naphthylamine Te derivatives, 18: 23695

KIRKOVA, E. K., Coprecipitation of Ce with K_2SO_4. III., 18: 23539

KIRSLIS, S. S., Sessile drops of molten halides on graphite and metals, 18: 23437 (CONF-322-12)

KISCHER, C. Ward, Intranuclear stratification in amoeba, 18: 23197 (ANL-6823(p.169-73))

KISCHER, C. Ward, Isolation cell components from *Amoeba proteus*, 18: 23191 (ANL-6823(p.118-23))

KISDI, D., Statistical theory of atomic nuclei. V., 18: 24633

KISELEV, B. P., Separation of Ba and Sr by exchange, 18: 23734

KISELEVA, E. D., Separation of Np-239 from irradiated U, 18: 23726

KITAMURA, Susumu, Gamma-induced graft polymerization of 2-methyl 5-vinyl pyridine and styrene, 18: 23584 (AEC-tr-6316(p.79-83))

KITAMURA, T., High-energy muon flux at sea level, 18: 24336

KITANISHI, Yasuhisa, Radiation-induced polymerization of diketene, 18: 23603 (AEC-tr-6316(p.186-9))

KITANISHI, Yasuhisa, Radiation-induced polymerization of β-propiolactone, 18: 23604 (AEC-tr-6316(p.190-4))

KITANISHI, Yasuhisa, Radiation-induced polymerization by ring cleavage, 18: 23606 (AEC-tr-6316(p.208-11))

KITANISHI, Yasuhisa, Structure of polymers formed by radiation-induced ring cleavage, 18: 24148 (AEC-tr-6316(p.212-16))

KITANO, Hakko, Gamma-induced polymerization of 4-vinyl pyridine, 18: 23632 (AEC-tr-6316(p.440))

KITANO, Hakko, Gamma-induced polymerization of 5-ethyl 2-vinyl pyridine, 18: 23633 (AEC-tr-6316(p.441))

KITOH, Shunji, Gamma irradiation of onion bulbs, 18: 23255

KITRILAKIS, S. S., Prog. rpt. on additive converter studies, 9/63, 18: 24350 (AD-418276)

KIYANOVSKII, M. P., Geomagnetic and ionospheric disturbances at middle latitudes, 18: 24534

KLABUKOV, A. M., Laboratory measuring-registering center, 18: 23861

KLADNITSKAYA, E. N., Radiative resonance decays involving Λ hyperons, 18: 24387 (JINR-P-1615)

KLEIN, E., Nuclei formation and crystal growth in preparation of nuclear track, 18: 23489

KLEIN, Peter D., Isotope separation factors occurring in chromatography of dual-labeled compounds, 18: 23194 (ANL-6823(p.141-51))

KLEINKNECHT, H. P., High-purity Ge—surface conduction and carrier life, 18: 25030 (ORNL-tr-120)

KLEMM, Wilhelm, Some fusible electrolytes, 18: 23456 (AI-Trans-46)

KLEMPARSKAYA, N. N., Therapeutic effects of procaine in acute radiation sickness, 18: 23384

KLETT, R. D., Re-entry flight demonstration number one, 18: 24941 (SC-RR-64-501)

KLEY, W., Inelastic scattering of neutrons on V hydride, 18: 24605 (NP-13930(p.59-71))

KLIGER, G. K., Production of π mesons in 650-Mev pp collisions, 18: 24476

KLOKMAN, V. R., Complex formation in recrystallization in $PbCl_2$–$SrCl_2$–RbCl and $PbCl_2$–$SrCl_2$–CsCl systems, 18: 23540

KLOKMAN, V. R., Influence of melt nature on formation of mixed crystals CaF_2–CeF_3 and CaF_2–YF_3, 18: 23533

KLOVERSTROM, F. A., Safety analysis for Super Kukla Prompt Burst Reactor, 18: 24964 (UCRL-7695)

KLUMB, H., Focusing of fast particle beams by extended cathodes, 18: 24237

KMIOTEK, Edmund, Temperature computation in multi-tube reactor fuel element, 18: 24867

KNABE, W. E., Plasma with electric, magnetic and fluiddynamic fields, 18: 24746 (ARL-64-34)

KNIGHTS, Herbert Chilvers, Expansion joints for pressurized fluid circuits, 18: 24835

KNOBLOKH, V., Yield of fission fragments from heavy nucleus fission. I., 18: 24690

KNOX, C. F., Cyclotron instabilities in a plasma stream, 18: 24790

KNOX, F. B., Bibliography on containment of plasma, 18: 24748 (CLM-Bib-4)

KNOX, F. B., Production of field-aligned ionization irregularities in the

equatorial electrojet, 18: 24539
KOBAYASHI, Kazuyuki, Radioisotope renogram and clinical application, 18: 23393
KOBAYASHI, S., Elastic scattering of 55-Mev protons by heavy nuclei, 18: 24665
KOBISCH, Christian, Measuring U in biological media, 18: 23405 (CEA-R-2415)
KOCH, D. W., Prog. rpt. on Na-heated steam generator, 3/64, 18: 23770 (TID-20604)
KOCHAROV, G. E., Interaction between ultra-high-energy cosmic rays and neutrinos, 18: 24348
KOCHEROV, N. P., Structure changes in tracks in developing nuclear emulsions, 18: 23924
KODOCHIGOV, P. N., Separation of Np-239 from irradiated U, 18: 23726
KODRAS, F. D., Radiation levels within and behind BeO, 18: 24806 (XDC-61-1-149)
KOECHLIN, Y., Analysis of tracks created in Pb-plate spark chamber, 18: 23973
KOEHLER, P. F. M., Quasifree proton-deuteron scattering corrections, 18: 24450
KOEHLER, W. C., Antiferromagnetism of Pr, 18: 24172
KOEHLER, W. C., Magnetic structures of rare earth Mn oxides, 18: 23523
KOEHLER, W. C., Magnetic structures of rare earth manganites ($RMnO_3$), 18: 24128 (CONF-405-34)
KOESTER, L., Construction and manner of operation of neutron refractometer, 18: 23838 (NP-13930(p.122-4))
KOESTER, Werner, Influence of heat treatment and neutron irradiation on Au–Mn alloys, 18: 24210
KOEVESY, Zs., Interstellar neutrino density and cosmogony, 18: 24273
KOHN, Henry I., RBE of high-energy photons and electrons, 18: 23314
KOKHONOV, M. F., Structural changes and physical properties of reactor IRT-2000, 18: 24960 (NP-13911)
KOLCHIN, A. A., Separation of Ba and Sr by exchange, 18: 23734
KOLEROV, G. I., Acausality and dispersion relations, 18: 24383(JINR-E-1646)
KOLESNIKOV, A. A., Extraction system $La(NO_3)_3$–HNO_3–H_2O–$(C_4H_9O)_3PO$ at 25°, 18: 23712
KOLESNIKOVA, N. S., Complex formation in recrystallization in $PbCl_2$–$SrCl_2$–RbCl and $PbCl_2$–$SrCl_2$–CsCl systems, 18: 23540
KOLESOV, G. M., Rare earth spallation products, 18: 24691
KOLGANOV, V. Z., Production of π mesons in 650-Mev pp collisions, 18: 24476
KOLLMER, W. E., Effect of Ca-rich diet on Sr-90 retention, 18: 23216
KOLLTVEIT, K., Separation method in shell-model calculation, 18: 24649
KOLODII, B. I., Asymptotic behavior of pion form factor at high transmitted impulses, 18: 24471
KOLOMEETS, E. V., Effect of small bursts in cosmic-ray hard component, 18: 24334
KOLOMIITSEVA, I. K., Synthesis of lipids in irradiated organisms, 18: 23301
KOLOMIYCHENKO, M. A., Synthesis and transformation of amino acids and other organic compounds by radiation, 18: 23204 (JPRS-24164(p.19-42))
KOLSKI, Gerald B., Polarizability of closed-cage $B_{10}H_{10}^{=}$, 18: 23487
KOMAR, A. P., Quantometer having constant-sensitivity γ radiation above 15 Mev, 18: 23899
KOMENDA, W., Cross section measurements on Pd for epithermal neutron energies, 18: 24609 (NP-13930(p.112-13))
KOMPE, D., Karlsruhe Van de Graaff project for fast neutrons, 18: 24246 (NP-13930(p.137-8))
KONDRATENKO, P. S., Theory of ferromagnetic Fermi fluid, 18: 24238
KONSTANTINOV, B. P., Interaction between ultra-high-energy cosmic rays and neutrinos, 18: 24348
KONTOROVICH, V. M., Wave transformation on plasma boundary in magnetic field, 18: 24766 (JPRS-24633(p.62-77))
KOOSMAN, J. G., Photomultiplier manufacturing process, 18: 23865
KOPPANG, R. R., Particle disintegration study for re-entering NAP systems, 18: 24933 (AFSWC-TDR-63-51)
KOPPEL, Juan U., Lattice vibrational spectrum of Be, 18: 24168
KOPVILLEM, U. Kh., Deformation cooling, 18: 24703
KOPYLOV, G. I., Radiative resonance decays involving Λ hyperons, 18: 24387 (JINR-P-1615)
KORKISCH, Johann, Prog. rpt. on separation of U and Th, 10/63–4/64, 18: 23707 (TID-20609)
KORNEEV, V. T., Yield of Na-24 from Al in H_2O during irradiation of Al, 18: 24592 (NP-13913)
KORNGOLD, G. C., Amino acids as punctuation in genetic code of DNA, 18: 25011 (TID-20348)
KOROTKOVA, V. P., Neuro-endocrine reaction to mercamine and antifeine and irradiation, 18: 23377
KOROTKOVA, V. P., Radioprotective properties of neurotropic pharmacological agents, 18: 23362 (JPRS-24817(p.1-8))
KORPAK, Wincenty, Extraction of U salts. III., 18: 23716
KORPUSOV, G. V., Isolation of carrier-free radioactive Ce from fission products, 18: 23727
KORSUNSKII, I. L., Neutron-neutron interaction in S-state, 18: 24398 (NP-13961)
KOSEK, Stanislaw, Fluorescent light emitted by aqueous solution in γ radiation field, 18: 23580 (PAN-488/XVII)
KOSHINO, Shigeharu, Optical quenching of ESR signals in neutron-irradiated ZnS, 18: 23664
KOSHINO, Shigeharu, Radiation-induced phase transition in ZnS, 18: 23665
KOSSLER, William J., Jr., Nuclear moments of C-11 from $^3P_2$ and $^3P_1$ hyperfine structure, 18: 24622 (PUC-1963-126)
KOSTIN, V. N., Effects of h-f electric field on glow discharge, 18: 24796
KOTHARI, D. S., Persistent currents in rotating superconductors, 18: 24549
KOTHARI, L. S., Effect of lattice structure on neutron diffusion, 18: 24577
KOTRELEV, V. N., Evaluation of plastic lining materials, 18: 25022 (ANL-Trans-15)
KOVBA, L. M., Conditions for formation of modifications of UO_2, 18: 23475
KOWALSKI, Henryk, Distribution of I-131 in thyroid gland, 18: 23218
KOZLOV, Ye. P., Effects of monomers on γ-irradiated erythrocytes, 18: 23381
KRAMER, G., Photoproduction of pions and Regge poles, 18: 24380 (DESY-64/3)
KRAMMER, Gordon, Lithium-drifted Si p-i-n junction as x and γ dosimeter, 18: 23967
KRAMSKOI, G. D., Linear electron accelerator up to 90 Mev, 18: 24245 (NP-13914)
KRASNIKOV, A. A., Linear electron accelerator up to 90 Mev, 18: 24245 (NP-13914)
KRASOVSKII, V. I., Geophysical investigations by means of Cosmos 3 and 5, 18: 24328
KRASOVSKII, V. I., Some characteristics of geoactive particles, 18: 24327
KRAUSS, J. J., Design and evaluation of perforated ion emitters, 18: 24366 (ASD-TDR-63-750)
KREN, E., Antiferromagnetic-ferromagnetic transformation in FeRh, 18: 24166
KRESTOVNIKOVA, T. I., Hypersensitization of layers of emulsion for nuclear studies, 18: 23551
KRESTOVNIKOVA, T. I., Methods for treating unsupported layers of emulsion, 18: 23926
KRETOVICH, V. L., Effect of D_2O on physical properties of wheat gluten, 18: 23477
KREY, P. W., Prog. rpt. on high-altitude balloon sampling, 4/24/64, 18: 23791 (NYO-10496(Add.))
KREYGER, P. J., Sessile drops of molten halides on graphite and metals, 18: 23437 (CONF-322-12)
KRIEGEL, H., Effect of Ca-rich diet on Sr-90 retention, 18: 23216
KRIM, M., Amino acids as punctuation in genetic code of DNA, 18: 25011 (TID-20348)
KRIPYAKEVICH, P. I., Crystal structures of Sc compounds with transition metals, 18: 24157
KRISE, G. M., Effects of continuous pre- and postnatal irradiation on reproduction in the albino rat, 18: 23343
KRISE, George M., Effect of continuous radiation on reproductive capacity and fertility, 18: 23328
KRIVOKHATSKAYA, I. V., Separation of As and Ge phenyl derivatives by partition chromatography, 18: 23733
KRLIN, Ladislav, Solution of state of beam of electrons at certain perturbation of field of accelerator, 18: 24256
KRONENBERGER, K., Quadrupole h-f mass spectrometer for vacuum applications, 18: 23433

KROTKIEWSKI, Marcin, Distribution of I-131 in thyroid gland, 18: 23218

KRUEGER, G., Multichannel analysis by use of an on-line computer, 18: 23859

KRUGLOV, S. P., Quantometer having constant-sensitivity γ radiation above 15 Mev, 18: 23899

KRUGLYKH, A. A., Vapor pressure of solid Y, 18: 24177

KRUMBEIN, A. D., Minimum-weight proton shields, 18: 24805 (UNC-5049)

KRUPENNIKOVA, A. Yu., Sorption of Sr ions on Na molecular screen, 18: 23717

KRZHIVANEK, M., Chromatographic separation of rare earths, 18: 23722

KRZHIVANEK, M., Reactions of heavy elements with multicharged ions. II., 18: 24689

KRZHIVANEK, M., Yield of fission fragments from heavy nucleus fission. I., 18: 24690

KU, Chen-son, Thermal expansion of O-18 H_2O, 18: 23546

KUANG, Hao-hwei, Nuclear interactions of cosmic high-energy particles, 18: 24346

KUCEROVSKY, Zdenek, Dead time of quenching circuit for G-M counter, 18: 23898

KUCHIN, I. A., Single-meson exchange and asymptotic behavior of nucleon and pion scattering on nucleons, 18: 24477

KUDRYAVTSEV, E. M., Gas states behind reflected shock waves, 18: 24236

KUERSTEN, H., Cold neutrons by total reflection, 18: 24569 (NP-13930 (p.119-20))

KUETTNER, Klaus E., Studies on ossifying cartilage, 18: 23188 (ANL-6823(p.102-4))

KUGO, Eiko, Gamma-induced graft polymerization of styrene on methanol, 18: 23581 (AEC-tr-6316(p.66-9))

KUHLMAN, Henry, Thermal expansion of isotopically enriched Li, 18: 23450 (TID-20252)

KUHN, Werner, Freezing point depression due to anomalous crystal habit, 18: 25028 (ORNL-tr-72)

KUIVINEN, Charles E., Finite-resistivity instability of tubular sheet pinch, 18: 24762 (UCRL-7077)

KULT, K., Acceleration of α particles in cyclotron U-120, 18: 24260

KUMAR, Krishna, Nuclear deformations in pairing-plus-quadrupole model I, 18: 24614 (NP-13941)

KUMAR, Raj, Studies of U(VI) complex with 3-phenyldaphnetin, 18: 23429

KUNII, Akira, Tumor induction with At-211 in rats, 18: 23261

KUNZE, Barbara, Program to simulate two-component chromatogram, 18: 23195 (ANL-6823(p.152-6))

KURASHOV, A. A., Search for light neutron nuclei, 18: 24616 (NP-13964)

KURATH, Dieter, Form factors for magnetic-dipole electron scattering, 18: 24676

KURI, Zenichiro, ESR absorption of radicals formed in sugars, 18: 23651 (AEC-tr-6316(p.573-86))

KURI, Zenichiro, ESR absorption of irradiated acrylamide and meta-acrylamide, 18: 23652 (AEC-tr-6316(p.587-97))

KURI, Zenichiro, ESR of α,α'-diphenyl-β-picryl hydrazyl, 18: 23399 (AEC-tr-6316(p.551-7))

KURI, Zenichiro, Free radicals from polymers irradiated with UV, 18: 23653 (AEC-tr-6316(p.598-602))

KURI, Zenichiro, Free radical formation in polymers, 18: 23654 (AEC-tr-6316(p.609-15))

KURI, Zenichiro, Radiation-induced graft polymerization of cellulose, 18: 23643 (AEC-tr-6316(p.498-500))

KURI, Zenichiro, Radiation-induced oxidation of cyclohexane, 18: 23655 (AEC-tr-6316(p.616-22))

KURI, Zenichiro, Reactions of irradiated acrylamide and meta-acrylamide with gases, 18: 23650 (AEC-tr-6316(p.567-72))

KURI, Zenichiro, Saturation factor of free radicals, 18: 24220 (AEC-tr-6316(p.603-8))

KURNISHKOV, I. S., Radiosensitivity of animals, 18: 23251 (JPRS-24803)

KURNOSOVA, L. V., Controlled exposure of nuclear emulsions on sputniks, 18: 23957

KURNOSOVA, L. V., Cosmic rays and radiation belts, 18: 24347

KUROSU, Tatuo, Liquid flowing neutron monitor, 18: 23896

KURZ, Richard J., FORTRAN II—program to compute neutron-detection efficiency of scintillator, 18: 23891 (UCRL-11339)

KUTHE, R., State of shock wave and temperature dependence of specific heat, 18: 24303

KUTI, G., Model with superconducting solution in quantum field theory. II., 18: 24485

KUTIK, I. M., Wave transformation on plasma boundary in magnetic field, 18: 24766 (JPRS-24633(p.62-77))

KUTIKOV, I. E., Number of neutrons emitted by U-235 fission fragments, 18: 24701

KUZINA, M. G., Hydrogen bond in alkyl amine salts. I., 18: 23576

KUZINA, M. G., Infrared spectra and structure of uranyl nitrate complex, 18: 23535

KUZINA, M. G., Stoichiometry of compound formed by uranyl nitrate and TOA nitrate, 18: 23544

KUZ'MA, Yu. B., Crystal structures of Sc compounds with transition metals, 18: 24157

KUZMIN, V. A., Problems in neutrino physics, 18: 24295

KUZMIN, V. N., Nuclear emulsions for investigation of scattering of protons on He-4, 18: 23948

KUZNETSOV, A. A., Radiative resonance decays involving Λ hyperons, 18: 24387 (JINR-P-1615)

KUZNETSOVA, N. N., Disruption of plant metabolism caused by treating seeds with radioactive substances, 18: 23205 (JPRS-24290(p.36-42))

KWIECINSKA, T., Stripping reactions in bombardment of Ta with Ne-20 ions, 18: 24717

L

LABARRE, J., Rapid iodination of human growth hormone with I-131, 18: 23225

LABAU, V., Mechanism of sensitization of photographic emulsion by T.E.A., 18: 23552

LA CHANCE, Leo E., Enhancement of radiation-induced sterility by CO_2 + air, 18: 23276

LACY, Dennis, Comparison of effects produced by high doses of radiation and estrogenic hormone, 18: 23332

LADU, M., Measurements of fast neutrons by BF_3 proportional counter, 18: 23900

LAFFON, Jean Louis, Enhanced polarization nuclear-free precession magnetometer, 18: 23869

LAGONI, H., Distribution of fallout products in milk, 18: 23800

LAI, S. T., Radiation genetics of Rhesus monkey, *Macaca mulatta.* I., 18: 23317

LAIRD, Anne Kane, Isolation cell components from *Amoeba proteus,* 18: 23191 (ANL-6823(p.118-23))

LAKSHMI, N. T. Venkata, Lifetimes of charged Σ hyperons, 18: 24415

LALLEMENT, Robert, Resistivity of tri-rare earth carbides of Sn, Gd, Er, and Dy, 18: 23511

LAMBERT, Joseph B., Nitrogen-15 magnetic resonance spectroscopy. I., 18: 23530

LAMBERT, M., Point-by-point study of surface of crystal, 18: 25035 (UCRL-Trans-1055(L))

LAMISSE, Michel, Preparation and study of uranyl and U(IV) salts, 18: 23473

LAMOUREUX, G., Rapid iodination of human growth hormone with I-131, 18: 23225

LAND, William H., Strontium-90 content of human bones 1961-63, 18: 23833

LANDAHL, H. D., Sodium nitrite in radioprotection in mice, 18: 23356 (NP-13918(p.99-106))

LANDKAMMER, J., Comparison of coherent scattering lengths on a neutron interferometer, 18: 23878 (NP-13930(p.76-7))

LANE, Frank W., Jr., Dosimetry for intracavitary Ra applicators, 18: 23395

LANG, D. W., Prompt neutrons from spontaneous fission of Cf-252, 18: 24651

LANGBERG, Edwin, Prog. rpt. on magnetically confined plasma duplexer, 5–8/63, 18: 24740 (AD-426769)

LANGHAM, Wright H., Physiological properties of Pu and body burden in man, 18: 23825 (LADC-6104)

LAPAT, P. E., Prog. rpt. on thermodynamics of U–N system, annual, 1/64, 18: 23454 (UNC-5077)

LAPITSKII, A. V., Thorium acetates, 18: 23543

LA POINTE, M., Existence of extensive showers of primary γ radiation, 18: 24342

LATHROP, Kaye D., Anisotropic scattering approximations, 18: 24565

(LA-3051)
LAVAKARE, P. J., Nuclear interactions of 900-Mev α particles, 18: 24619 (NYO-10269)
LAVRUKHINA, A. K., Rare earth spallation products, 18: 24691
LAVUT, E. G., Conditions for formation of modifications of UO_2, 18: 23475
LAWLOR, Patrick J., Propellant feed systems for ion engines, 18: 23754 (NASA-CR-51)
LAZARUS, A., Plasma measurements on IPM-A, 18: 24749 (CONF-521-2)
LEACH, S. J., Tritium–H exchange in keratins, 18: 23211
LEACHMANN, R. B., Reaction $C^{12}(C^{12},\alpha)Ne^{20}$, 18: 24724
LEADER, Elliot, Analysis of NN and $N\bar{N}$ total cross sections, 18: 24452
LE BARGY, R. C., Spectrum of gaseous ScF, 18: 23531
LEBEDEV, A. N., Participation of thalamus opticus in brain cortex reaction to whole-body irradiation, 18: 23308
LEBEDEV, A. V., Production of π mesons in 650-Mev pp collisions, 18: 24476
LEBEDEV, V. I., Number of neutrons emitted by U-235 fission fragments, 18: 24701
LEBEDEV, V. V., Separation of Ba and Sr by exchange, 18: 23734
LEBEDEVA, O. P., Radiation sickness in mice subjected to treatment with bone marrow and immunization, 18: 23366
LEE, Byung-kook, Complexes of La and other rare earth (III) ions, 18: 23518
LEE, K. S. H., Doppler effect in a medium, 18: 24741 (AFOSR-5367)
LEE, T. D., Leptonic decays of the intermediate boson W, 18: 24464
LEE, W. W., X-ray fluorescence tables for topaz crystal, 18: 24216 (Y-1470-B)
LEE-FRANZINI, Juliet, Lifetimes of massive triplets, 18: 24467
LEGAR, F., Spin correlation coefficients in elastic 315-Mev scattering, 18: 24389 (JINR-P-1617)
LEGRAND, J., Quantitative β and γ spectrometric analysis, 18: 23434
LEIFER, R., Proton relaxation times in alkali halide solutions, 18: 23559
LEITH, D. W. G., Production mechanism for reaction $K^+p \rightarrow K^+p$ at 3 Bev/c, 18: 24449
LEITTEN, C. F., Jr., Postirradiation evaluation of stainless steel-clad plate-type specimens, 18: 24195 (ORNL-TM-815)
LELAND, W. T., (He^3,n) reactions on various light nuclei, 18: 24650
LELEK, V., π-Meson scattering on nucleons. II., 18: 24414
LEMESLE, Georges, Moderator structure for a nuclear reactor, 18: 24838
LEMPICKI, Alexander, Stimulated emission processes in rare earth chelates, 18: 24229
LENG, J., Computer for nuclear physics experiments, 18: 23858
LENG, M., Remote interactions within macromolecular chains, 18: 25034 (SC-T-64-902)
LENNES, G., Radioprotective effects of alkaline earth chlorides on barley, 18: 23368
LEPECHINSKY, D., Plasma instabilities, 18: 24780
LESSMANN, Kurt R., Purifying waste gases, 18: 23836
LETEURTRE, J., Dislocations of alpha U, 18: 24201 (ANL-Trans-22)
LEUTWYLER, H., Equivalence of Feynman and canonical quantization, 18: 24232
LEVIN, V. I., Isolation of carrier-free radioactive Ce from fission products, 18: 23727
LEVINE, D., Solution of two master equations coupled by particle exchange, 18: 24233
LEVI-SETTI, Riccardo, Elementary particles, 18: 24482
LEVITIN, R. Z., Ferro- and antiferromagnetism of rare earths, 18: 24178
LEVY-PASCAL, A. E., Particle disintegration study for re-entering NAP systems, 18: 24933 (AFSWC-TDR-63-51)
LEWIS, F. H., Jr., Form factors for strong M1 transitions in light nuclei, 18: 24675
LI, Cheng-wu, High-energy injection of particles in mirror machine, 18: 24767 (KFK-tr-141)
LIAN, Go-chen, Stripping reactions in bombardment of Ta with Ne-20 ions, 18: 24717
LIANG, Shu-chuan, Separation and analysis of rare earth elements, 18: 23709 (JPRS-24552(p.57-9))
LIANG, Shu-chuan, Utilization of α-methoxy-benzyl-acetic acid as precipitant for Zr, 18: 23415 (JPRS-24552(p.60-1))
LIANG, Shu-quan, Separation of rare earth elements by chromatographic method, 18: 23715
LIBBY, W. F., Heavy hydrocarbons from solid methane by ionizing radiation, 18: 23697
LIBOUREL, F., Gamma-particle discrimination in emulsions by development, 18: 23912
LIFSHITZ, E. V., Spectroscopic observation of electron-ray melting, 18: 24798
LILJEBLAD, Ragnar, Views on the theory of relativity, 18: 24491
LILOVA, O. M., Properties of sulfostyrene cation exchange resins, 18: 23736
LIMA E SANTOS, Manuel, Yields of H_2O_2 from radiolysis of aqueous solutions, 18: 23675
LIN, M. S., Magnetic susceptibility of several rare earth oxides, 18: 23513
LIND, M. D., Complexes of La and other rare earth (III) ions, 18: 23518
LINDELL, Bo, Radioactivity measurements on food, 1962, 18: 23790 (NP-13828)
LINDENBAUM, Arthur, Plutonium removal. VII., 18: 23350 (ANL-6823 (p.105-8))
LINDENBAUM, Arthur, Plutonium removal. V., 18: 23351 (ANL-6823 (p.114-15))
LINDENBAUM, Arthur, Plutonium removal. VIII., 18: 23189 (ANL-6823(p.109-10))
LINDENBAUM, Arthur, Plutonium removal. IX., 18: 23190 (ANL-6823 (p.111-13))
LINDENBAUM, Arthur, Studies on ossifying cartilage, 18: 23188 (ANL-6823(p.102-4))
LINHARD, J. G., Fusion—progress realized in last two years, 18: 24779
LINHART, Jiri George, Generation of strong magnetic fields, 18: 24804
LINSENMEYER, John C., Nuclear reactor, 18: 24819
LIPKOVSKII, A. A., Infrared spectra and structure of uranyl nitrate complex, 18: 23535
LIPOVSKII, A. A., Hydrogen bond in alkyl amine salts. I., 18: 23576
LIPOVSKII, A. A., Hydrogen bond in alkyl amine salts. II., 18: 23577
LIPOVSKII, A. A., Stoichiometry of compound formed by uranyl nitrate and TOA nitrate, 18: 23544
LITTLE, W. A., Possibility of synthesizing an organic superconductor, 18: 24554
LIU, T. T., Radiation genetics of Rhesus monkey, *Macaca mulatta*. I., 18: 23317
LLOYD, R. D., $Sr^{90} + Y^{90}$ bremsstrahlung efficiency in bone, 18: 23173
LOCK, W. O., Applications of emulsions to high-energy nuclear physics at CERN, 18: 24261
LOEVSETH, J., Muon capture in heavy nuclei, 18: 24658
LOMBARD, Louise S., Prog. rpt. on toxicity and metabolism of radionuclides, 6/63, 18: 23184 (ANL-6823(p.44-75))
LOMOVA, M. A., Mobility of fatty acids in γ-irradiated animals, 18: 23302
LONCHAMP, J. P., Interaction mechanisms of 200-Mev Ne-20 with Ag and Br nuclei, 18: 24732
LONG, Everett, Nuclear reactors, 18: 24843
LONGO, Michael J., Elastic scattering of π^+ by protons, 18: 24453
LONGO, Michael J., Elastic scattering of π^- by protons, 18: 24454
LOPATIN, I. V., Quantometer having constant-sensitivity γ radiation above 15 Mev, 18: 23899
LOPATINA, E. A., Results obtained with emulsions in magnetic field, 18: 23946
LOPATO, L. M., Diagram of system Sc_2O_3–MgO, 18: 23529
LOPUKHIN, V. M., Space-charge fast wave noise removal by resonator, 18: 23848
LORD, J. J., Detection of low-intensity radiations with nuclear emulsions, 18: 23921
LORIKYAN, M. P., Ionization energy losses by fast electrons in thin polystyrene layers, 18: 24702
LOSHAK, A. Ya., Accumulation of I-131 by skin and hairs, 18: 23207 (JPRS-24704(p.6-11))
LOTT, James R., Effects of Na azide in isolated x-irradiated nerve fibres, 18: 23277
LOUCKS, T. L., Fermi surface of Be, 18: 24171
LOUDE, J. F., Angular distribution inelastic diffusion of neutrons in C, 18: 24603 (NP-13930(p.51-3))
LOUNASMAA, O. V., Specific heat of Tm metal, 18: 23442 (CONF-405-4
LOVELL, L., Evidence that the f^0 has isotopic spin zero, 18: 24466
LOVELOCK, David, Formulation of relativistic wave equations, 18: 2449
LOVERING, J. F., Rhenium and Os abundances in stony meteorites,

18: 24292

LOVERING, J. F., Uranium and Th abundances in stony meteorites. I., 18: 24285

LOVERING, J. F., Uranium and Th abundances in stony meteorites. II., 18: 24286

LOW, W., ESR studies with superconducting magnets, 18: 23524

LOWTHIAN, Charles Stewart, Improvements in cooling of concrete vessels, 18: 24830

LOZHKIN, O. V., Discrimination of heavy ions in nuclear emulsion, 18: 23954

LOZYNSKI, E., Stripping reactions in bombardment of Ta with Ne-20 ions, 18: 24717

LUBKIN, E., Critique of space-time variables in physical theory, 18: 24495

LUCHNIK, N. V., Influence of fractionation and dosage on cytological effect of radiation, 18: 23252 (ORNL-tr-84)

LUDWIG, G., Derivation of Boltzmann's equation. I., 18: 24507

LUETJENS, G., Neutral decay and isotopic spin of the f^0, 18: 24463

LUETKEN, Hans, Coulomb excitation in deformed nuclei, 18: 24641

LUETKEN, Hans, Multiple coulomb excitation in deformed nuclei, 18: 24728

LUKE, P. S., Jr., Prog. rpt. on nuclear burnup analyses, 9–11/63, 18: 24856 (GEAP-4430)

LUNDIN, C. E., Vapor pressures of Sm and Gd, 18: 23439 (CONF-405-36)

LUO, H. L., Superconducting metastable compounds, 18: 24142 (TID-20617)

LUSHCHIKOV, V. I., Polarization of protons in single crystals of LaMg double nitrate, 18: 23444 (JINR-P-1626)

LUSTIG, C. D., High-intensity microwave noise resonances from rare gas discharges, 18: 24772

LUSTIG, C. D., Microwave noise resonances from plasma column, 18: 24786

LUTWAK, Leo, Calcium absorption in man, 18: 23226

LUUKKALA, Mauri, Quadrupole splitting in NMR of Na-23 in $NaClO_4$, 18: 23464

LYNCH, C. T., Stabilization of cubic zirconia, 18: 23503

LYNCH, G. R., Production mechanism for reaction $K^+p \to K^*p$ at 3 Bev/c, 18: 24449

LYNCH, J. F., Refractory ceramics of interest in aerospace structural applications, 18: 24141 (RTD-TDR-63-4102)

LYON, E., Plasma measurements on IPM-A, 18: 24749 (CONF-521-2)

LYUBIMOV, V. A., Ionizing ability of particles in spark chamber, 18: 24473

LYUBIMOV, V. B., Investigations of γ-quanta, produced in interactions of π^--mesons with nucleons and nuclei at ≈7 Bev, 18: 24391 (JINR-P-1629)

LYUBIMOV, V. B., Properties of π^0 mesons produced in π^--N and π^--C interactions, 18: 24390 (JINR-P-1624)

LYUFACHUN, A. S., Effects of serotonin on hematopoietic system in irradiated rats, 18: 23376

M

MA, Benjamin M., Analysis for cylindrical fuel elements of fast reactor, 18: 24943

MAC DONALD, Norman S., Effect of tetracycline on retention of Ca and Sr in rodents, 18: 23220

MAC DOUGALL, J. D., Mass effect corresponding to nuclear deformation in region $N \sim 90$, 18: 24681

MAC GREGOR, A. G., Effects of x irradiation on rat thyroid gland, 18: 23260

MAC GREGOR, M. H., Nucleon-nucleon elastic scattering matrix. I., 18: 24403 (UCRL-7563-T)

MACKE, W., Description and hydrodynamical approximation for classical plasma, 18: 24770

MACKE, W., Graphical presentation of S operators with many-particle problem, 18: 24486

MAC PHERSON, R. E., Graphite oxidation and mass transport test facility, 18: 23447 (ORNL-TM-831)

MACRAE, W., Latina power station, 18: 24923

MADELMONT, Claude, Pollution of milk by I-131, 18: 23819 (CEA-R-2409)

MAENNER, W., Forward production of photons from 9-Bev π-p interactions, 18: 24417

MAGLADRY, Robert, High-performance water plants, 18: 24901 (NP-13900 (Sect.8))

MAHAJAN, B. G., Cation-exchange resin for total anion analysis of solutions containing Be(II) ion, 18: 23423

MAHANTHAPPA, K. T., Generalization of Chew's reciprocal bootstrap to SU(3), 18: 24431

MAHANTHAPPA, K. T., Meson–baryon resonances in $U(3) \otimes U(3)$ symmetry, 18: 24465

MAHLMAN, H. A., Radiolytic reduction of aqueous Ag nitrate solutions, 18: 23687

MAISIN, J. R., Cells of duodenum of mouse after x irradiation, 18: 23266

MAJLE, Tadeusz, Distribution of I-131 in thyroid gland, 18: 23218

MAKHNOVSKII, E. D., Photoprotons from Li-6, 18: 24695

MAKI, Nobufumi, Observation of fallout, 18: 23793

MAKI, Nobufumi, Solubility of fallout particles, 18: 23795

MAKSIMOVICH, N. A., Radiation sickness in mice subjected to treatment with bone marrow and immunization, 18: 23366

MAKSYMOWICZ, A., Determination of form factors in $K_{\mu 3}$ decays, 18: 24447

MALAVAL, P., Transistorized magnetic-tape recording and reading unit, 18: 23853

MALINOVSKII, O. V., Ploidy and radiosensitivity of yeast cells, 18: 23311

MALINOVSKY, A. H., Particle disintegration study for re-entering NAP systems, 18: 24933 (AFSWC-TDR-63-51)

MALINOWSKA, C., Scattering cross section of low-energy electrons, 18: 24302

MAL'TSEV, V. M., Inelastic interactions of particles at high energies, 18: 24384 (JINR-P-1577)

MAL'TSEV, V. M., Production of particles in nuclei, 18: 24587 (JINR-P-1584)

MALY, J., Stripping reactions in bombardment of Ta with Ne-20 ions, 18: 24717

MALY, Ya., Chromatographic separation of rare earths, 18: 23722

MALY, Ya, Extraction properties of Fm and Md, 18: 23725

MALY, Ya., Reactions of heavy elements with multicharged ions. II., 18: 24689

MALY, Ya., Yield of fission fragments from heavy nucleus fission. I., 18: 24690

MAMURO, Tesuo, Humic acid as coagulation agent for Ca phosphate flocculation, 18: 24982

MAMURO, Tesuo, Observation of fallout, 18: 23793

MAMURO, Tetsuo, Artificial radioactive dust particles collected by an electrostatic precipitator, 18: 23796

MAMURO, Tetsuo, Decontamination of radioactive waste water, 18: 24981

MAMURO, Tetsuo, Decontamination of radioactive Ru, 18: 24983

MAMURO, Tetsuo, Dewatering property of radioactive sludge concentrator, 18: 24984

MAMURO, Tetsuo, Solubility of fallout particles, 18: 23795

MAMURO, Tetsuo, X-ray microanalysis of highly radioactive fallout particles, 18: 23794

MANDL, Anita M., Radiosensitivity of male primordial germ cells and spermatogonia, 18: 23331

MANDL, Anita M., Radiosensitivity of oogonia and oocytes at different stages, 18: 23340

MANGENEY, A., Kinetic equations for a homogeneous plasma, 18: 24789

MAN'KO, N. M., Isolation of carrier-free radioactive Ce from fission products, 18: 23727

MANN, R. A., Elastic scattering of slow electrons from alkali atoms, 18: 24298 (N64-13373)

MANNO, P. J., Radiation-initiated polymerization. II., 18: 23689

MANUEL, S., Effect of localized x rays on bone marrow, 18: 23265

MANUYLOV, N. N., Welding of Ti alloys, 18: 24106 (JPRS-24521(p.1-58))

MARCINKOWSKY, A. E., Non-aqueous $AgNO_3$ solutions: electrical conductance, 18: 25000 (RPI-1999-3)

MARCIO DO AMARAL, C., Regge trajectories for Coulomb potential, 18: 24430

MARGULIS, O. M., High-thermal resistance of products manufactured from ZrO_2, 18: 24111

MARIANO, Maria Helena, Yields of H_2O_2 from radiolysis of aqueous solutions, 18: 23675

MAR'IN, N. P., Diffusion of gas being absorbed in a medium, 18: 24333

MARINSKY, Jacob A., Ion exchange in concentrated electrolyte solutions. III., 18: 23480

MARIS, Th. A. J., Spin relaxation in x-γ angular correlations, 18: 24653

MARISH, K. S., Production of π mesons in 650-Mev pp collisions,

18: 24476

MARKEN, T. L., Oxygen/metal ratios for U, Pu and (U,Pu) oxides, 18: 23403 (AERE-R-4608)

MARKLEY, Joan F., Plutonium removal. VII., 18: 23350 (ANL-6823 (p.105-8))

MARKLEY, Joan F., Plutonium removal. V., 18: 23351 (ANL-6823 (p.114-15))

MARKLEY, Joan F., Plutonium removal. VIII., 18: 23189 (ANL-6823 (p.109-10))

MARKLEY, Joan F., Plutonium removal. IX., 18: 23190 (ANL-6823 (p.111-13))

MARKLEY, Joan F., Removal of polymeric Pu from mice, 18: 23369

MARKOCKI, W., Controlled Ostwald maturing of photographic emulsions, 18: 23491

MARKOCKI, Wladyslaw, Preparation methods for emulsions, 18: 23492

MAROCHNIK, L. S., Interaction of solar corpuscular streams, 18: 24282

MAROV, M. Ya., Geophysical investigations by means of Cosmos 3 and 5, 18: 24328

MAROV, M. Ya., Some characteristics of geoactive particles, 18: 24327

MARQUIT, E., Evidence that the f^0 has isotopic spin zero, 18: 24466

MARSHALL, J., Buckling and reaction rates in Pu–graphite assemblies, 18: 24852

MARTELLUCCI, S., Study of plasma refractivity, 18: 24783

MARTIN, A., Experience in fuel element cropping and irradiation ponds, 18: 23814 (AERE-R-4528(p.55-67))

MARTIN, A., Health physics control of research reactors, 18: 23809 (AERE-R-4528)

MARTIN, D. G., Scattering of long wavelength neutrons in graphite, 18: 24207

MARTIN, Jean-Claude, Separation of at least one constituent from gaseous mixture, 18: 23737

MARTIN, R., Design of reactor complex and loading mechanism, 18: 24919 (ORNL-tr-82)

MARTIN, R. L., Non-stoichiometry in ternary rare-earth oxide systems, 18: 23509

MARTIN, Roger, Moderator structure for a nuclear reactor, 18: 24838

MARTINIC, N., Verification of direction of arrival of EAS, 18: 24344

MARTYNOV, A. I., Linear electron accelerator up to 90 Mev, 18: 24245 (NP-13914)

MARTYSH, G. G., Discrimination capacity of nuclear emulsion using superproportional intensifying, 18: 23931

MARX, G., Interstellar neutrino density and cosmogony, 18: 24273

MARX, G., Model with superconducting solution in quantum field theory. II., 18: 24485

MASSA, D., Inactivation of aphthous virus by radiation, 18: 23246 (AERE-Trans-1000)

MASTRYUKOVA, V. M., Effects of high-energy protons on cornea epithelium, 18: 23303

MASUDA, N., Resonance poles in the multi-channel scattering amplitudes, 18: 24432

MASUDA, N., Resonance poles in the scattering amplitudes with unstable particles, 18: 24433

MATHIESON, E., Pulse-shape discrimination in proportional counters, 18: 23974

MATHIEU, R., Rapid iodination of human growth hormone with I-131, 18: 23225

MATHIS, A., Ispra-2—description and safety, 18: 24962 (RT/ING(63)-25)

MATHUR, P. C., Lifetimes of charged Σ hyperons, 18: 24415

MATRICON, J., Energy and elastic moduli of lattice of vortex lines, 18: 24230

MATRICON, J., Vortex line in type-II superconductor, 18: 24551

MATSON, Lorne J., Rate of spermatogenesis in man, 18: 23176

MATSUBAYASHI, Yasuhide, X-ray injury of experimental wound healing in mice, 18: 23273

MATSUDA, Koji, Beta dosimetry by discoloration of PVC film, 18: 23894 (AEC-tr-6316(p.46-58))

MATSUDA, Koji, Calorimetric determination of β flux, 18: 23893 (AEC-tr-6316(p.24-60))

MATSUDA, Koji, Distribution of β energy dissipation in absorbers. I., 18: 24626 (AEC-tr-6316(p.35-41))

MATSUDA, Koji, Distribution of β energy dissipation in absorbers. II., 18: 24627 (AEC-tr-6316(p.42-5))

MATSUDA, Koji, Gamma absorption adjacent to scattering bodies. I., 18: 24217 (AEC-tr-6316(p.9-16))

MATSUDA, Koji, Low-energy spectrum of β radiation, 18: 24628 (AEC-tr-6316(p.59-65))

MATSUGASHITA, Teikichi, ESR of irradiated teflon, 18: 23648 (AEC-tr-6316(p.534-7))

MATSUMOTO, Ryuichi, Heat transfer in a fluid fuel reactor, 18: 23775

MATSUMURA, Takeshi, Decontamination of radioactive waste water, 18: 24981

MATSUMURA, Takeshi, Decontamination of radioactive Ru, 18: 24983

MATSUMURA, Takeshi, Dewatering property of radioactive sludge concentrator, 18: 24984

MATSUMURA, Takeshi, Humic acid as coagulation agent for Ca phosphate flocculation, 18: 24982

MATSUNAMI, Tadao, Observation of fallout, 18: 23793

MATSUNAMI, Tadao, Solubility of fallout particles, 18: 23795

MATSUURA, Tomio, Radiation effect on surface phenomena of biological macromolecules, 18: 23690

MATTEUZZI, L., Ispra-2—description and safety, 18: 24962 (RT/ING(63)-25)

MATTEUZZI, L., Thermocouple irradiation tests, 18: 23840 (RT/ING(64)-2)

MATTHIAE, G., Use of internal beam of synchrotron for study of reaction (e,e′p), 18: 24243 (ISS-63/42)

MATTIEVICH, Enrico, Measurement of H-alpha flare spectrograms, 18: 24271 (NP-13803)

MATTISON, Lindsay, Quake at Bodega, 18: 23832

MATTUCK, R. D., Phonons from many-body viewpoint, 18: 24488

MATYUSHENKO, N. N., Thermal expansion of W and Mo disilicides, 18: 24173

MAURICE, H., Control of reactor Siloe, 18: 24966

MAUSBERG, W., Neutron interaction cross sections on Si, 18: 24600 (NP-13930(p.39-40))

MAXIE, E. C., Oxygen-dependent postirradiation restoration of *Rhizopus stolonifer* sporangiospores, 18: 23288

MAY, R. M., Electrical conductivity of a Lorentz gas, 18: 24785

MAY, Robert M., Collision damping of two-stream instabilities in plasma, 18: 24759 (NP-13950)

MAY, Robert M., Electrical conductivity of Lorentz gas, 18: 24761 (NP-13952)

MAY, Robert M., Production of highly excited neutral atoms for injection into plasma devices. II., 18: 24758 (NP-13949)

MAY, Robert M., Relaxation of fast ion in plasma, 18: 24760 (NP-13951)

MAYER, M. E., Formulation of gauge-invariance conditions in S-matrix theories, 18: 24497

MAYS, C. W., $Sr^{90} + Y^{90}$ bremsstrahlung efficiency in bone, 18: 23173

MAZZUCATO, E., Study of plasma refractivity, 18: 24783

MC ARTHUR, Richard D., Contained nuclear explosions for evaluation of mining applications, 18: 23751 (UCRL-7350)

MC CALLUM, J., Evaluating power sources, 18: 24363 (ANL-6802(p.163-5))

MC CLELLAN, R. O., Metabolism of SNAP radionuclides in swine, 18: 23200 (HW-SA-3350)

MC CREA, W. H., Why are all electrons alike?, 18: 24288

MC CULLOCH, D. B., Buckling and reaction rates in Pu–graphite assemblies, 18: 24852

MC DEVITT, Neil T., Infrared absorption study of metal oxides, 18: 235

MC DUFFEE, W. T., Recovery of Pu from irradiated Pu–Al alloy, 18: 237 (ORNL-3566)

MC DUFFIE, H. F., Kinetics of thermal decomposition of biphenyl, 18: 23570 (ORNL-3602)

MC ELHENY, Victor K., Particle accelerators at CERN, 18: 24263

MC GEE, J. P., High-temperature helium compressor, 18: 23745 (TID-7 (p.236-44))

MC GILL, Paul, Portable nuclear power plants, 18: 24900 (NP-13900 (Sect.6))

MC GONNAGLE, Warren J., Prog. rpt. on nondestructive testing instrumentation for reactor pressure vessels, 1–3/64, 18: 23780 (SWRI-1243-10)

MC HUGH, James A., Mass analysis of small samples utilizing sputtering ion source, 18: 23406 (CONF-512-4)

MC INTOSH, J. A. R., Effects of x irradiation on rat thyroid gland, 18: 23260

MC INTOSH, J. S., Nucleus-nucleus long-range interaction potential, 18: 24674
MC INTYRE, D. J., Radiation cataract in clinical therapeutic radiology, 18: 23313
MC INTYRE, J. A., Inelastic scattering of C-12 and O-16 by Pb-208, 18: 24708
MC INTYRE, L. C., Tensor polarization of deuterons scattered from He-4, 18: 24647
MC LATCHIE, W., Mass effect corresponding to nuclear deformation in region $N \sim 90$, 18: 24681
MC LAURIN, William A., Delay of postirradiation test fluids: factor in saccharin avoidance behavior, 18: 23290
MC MULLAN, Philip, Damage assessment and data base on shelter needs, 18: 23826 (NP-13942)
MC NEILLY, John H., Neutron-flux and γ-dose measurements at AFRRI reactor, 18: 24957 (NDL-TR-59)
MC RICKARD, S. B., Effect of twinning on yield stress of polycrystalline Fe, 18: 24129 (CONF-524-5)
MECH, Christian, Construction and operation of gas-bearing compressors, 18: 23744 (TID-7690(p.219-35))
MECH, Christian, Multi-pad gas bearings, 18: 23746 (TID-7690(p.263-72))
MEDNIKOVA, N. V., Geomagnetic and ionospheric disturbances at middle latitudes, 18: 24534
MEDVEDEV, S. S., Gas evolution and double bonds during PIB radiolysis, 18: 23669
MEFOD'EVA, M. P., Separation of Np-239 from irradiated U, 18: 23726
MEGUMI, Tsuneo, Effect of Cs-137 and Sr-90 on mice. II., 18: 23210
MEGUMI, Tsuneo, Radiation-induced leukemia in mice. I., 18: 23256
MEGY, J., Data processing in the control of nuclear reactors, 18: 24828
MEGY, M., Hot critical pile CESAR, 18: 24968
MEHTA, M., Changes in physical properties of rocks in the vicinity of underground nuclear explosions, 18: 23786 (UCRL-13105)
MEIJER, P. H. E., Solution of two master equations coupled by particle exchange, 18: 24233
MELA, R. L., Heat transfer effects in moderate accidents to fast reactors, 18: 24817 (NDA-14-134)
MELDNER, H., Transmission coefficients and absorption cross sections according to optical model, 18: 24595 (NP-13930(p.6-13))
MELIGY, A. S., Coulomb wave functions for low energies, 18: 24682
MELIKHOV, I. V., Coprecipitation of Ce with K_2SO_4. III., 18: 23539
MELLENTIN, K., Bibliography on high-energy physics, 18: 24214 (AED-C-23-01)
MELNIKOVA, N. N., Radiative resonance decays involving Λ hyperons, 18: 24387 (JINR-P-1615)
MERCER, R. A., Crystallization in Be-containing melts, 18: 23562
MERCIER, R. P., Radio-frequency emission coefficient of hot plasma, 18: 24792
MERIWETHER, J. R., Scattering of 65-Mev He ions from O-16, 18: 24623 (UCRL-10727)
MERRIAM, M. F., Superconducting metastable compounds, 18: 24142 (TID-20617)
MESERVEY, A. B., Zr–U processing equipment contamination and decontamination, 18: 23705 (ORNL-TM-837)
MESHITSUKA, Gisuke, Emission characteristics of ZnS phosphors, 18: 23693
METELMANN, C., Two-dimensional analog simulation for reactor, 18: 24847 (HW-79446)
MEYER, M. A., Energy spectrum of cosmic-ray pions, 18: 24341
MEYERHOF, Walter E., Neutron slowing down and absorption logging method, 18: 23868
MEZZETTI, L., Polarization of Λ^0 from $\gamma + p = K^+ + \Lambda^0$, 18: 24428
MIARS, F. H., O-ring seals at high pressure, 18: 25015 (UCRL-7359)
MICHEJDA, L., SIUP geometrical reconstruction program, 18: 23887 (PAN-474/VI)
MICHIYOSHI, Itaru, Heat transfer in a fluid fuel reactor, 18: 23775
MICHON, Georges, Pollution of milk by I-131, 18: 23819 (CEA-R-2409)
MIGDAL, A. B., New approach to theory of nucleus, 18: 24615 (NP-13959)
MIKAELIAN, L. A., Number of neutrons emitted by U-235 fission fragments, 18: 24701
MIKHAILOV, V. A., Mechanism of operation of track spark chambers, 18: 23968
MIKHALCHA, I., Separation of Au and Tl from a complex mixture by partition chromatography, 18: 23732
MIKHEEV, V. L., Spontaneously fissioning isomer produced in reactions with charged particles, 18: 24725
MIKK, G., Prog. rpt. on emissivity of materials, final, 7/59–12/62, 18: 24138 (PWA-2206(Vol.I))
MILES, J. L., Zero power experiments for SM-1 Core III, 18: 24873 (ACNP-64517(Rev.1))
MILLER, A. E., High-temperature allotropy of heavy rare-earth metals, 18: 24176
MILLER, L. B., ARGUS—program for calculating transient temperatures, 18: 23763 (ANL-6654)
MILLER, R. P., Crystallization in Be-containing melts, 18: 23562
MILLIGAN, Mancil W., Temperature distribution in EGCR vessel cooling compressor, 18: 24915 (TID-7690(p.166-75))
MILLING, Henry Miles, Improvements in cooling of concrete vessels, 18: 24830
MINACHEV, Kh. M., Isotopic exchange of H in hydrocarbons on rare earth oxides. II., 18: 23573
MINEGAWA, Namiko, Graft polymerization of styrene on pre-irradiated cellulose, 18: 23586 (AEC-tr-6316(p.89-94))
MINEGAWA, Namiko, Radiation-induced graftings on cellulose, 18: 23587 (AEC-tr-6316(p.95-9))
MINGUZZI, A., One-variable dispersion relations, 18: 24427
MINTZ, Michael D., Computer analysis of fluid flow involving real gases, 18: 23772 (UCRL-7530)
MISLOW, Kurt, Racemization of 9,10-dihydro-4,5-dimethylphenanthrene, 18: 23574
MITA, Itaru, Effect of radiation on thermal stability of polyethylene, 18: 23673
MITIN, V. I., Yield of Na-24 from Al in H_2O during irradiation of Al, 18: 24592 (NP-13913)
MITRA, A. N., Model for π-π resonance of $I = J = 0$, 18: 24443
MITRA, S. N., Radio method of detecting solar flares, 18: 24284
MITYUSHOVA, N. M., Ploidy and radiosensitivity of yeast cells, 18: 23311
MITZEL, F., Measurement of (n,γ) cross sections and resonance integrals, 18: 24608 (NP-13930(p.110-11))
MIYAZAKI, Toru, Free amino acid following x irradiation on radiological practicians, 18: 23319
MIZUIKE, Atsushi, Quantitative analysis utilizing isotopic exchange reaction, 18: 23430
MIZUMURA, Yasuji, Radioisotope renogram and clinical application, 18: 23393
MOFFAT, J. W., Existence of solutions of partial-wave dispersion relations, 18: 24425
MOISAR, E., Grain formation and photographic properties of emulsions, 18: 23490
MOISAR, E., Nuclei formation and crystal growth in preparation of nuclear track, 18: 23489
MOKROV, A. P., Formation and concentration of vacancies in Fe–Mo alloys, 18: 24160
MONK, C. B., Spectrophotometric studies of electrolytic dissociation. VII., 18: 23501
MONKS, A. L., Influence of fractionation and dosage on cytological effect of radiation, 18: 23252 (ORNL-tr-84)
MONTET, G., Field emission from crystals of graphite, 18: 24121 (ANL-6804)
MONTGOMERY, David, Test particle problem for electron plasma, 18: 24753 (N64-13056)
MONTGOMERY, Keith M., Propellant feed systems for ion engines, 18: 23754 (NASA-CR-51)
MONTUELLE, J., Structural properties of stainless steels, 18: 24151 (EURAEC-986)
MONTVAY, I., Determination of nuclear matrix elements, 18: 24629
MOON, R. M., Antiferromagnetism of Pr, 18: 24172
MOORE, Donald J., Rate of spermatogenesis in man, 18: 23176
MOORE, M. S., Fission cross section of Pu-241, 18: 24586 (IDO-16976)
MOOTE, F. G., Zero power experiments for SM-1 Core III, 18: 24873 (ACNP-64517(Rev.1))
MORAND, M., Granulation curves from sensitivity of ionographic emulsion, 18: 23909
MORGAN, J. W., Rhenium and Os abundances in stony meteorites, 18: 24292

MORGAN, J. W., Uranium and Th abundances in stony meteorites. I., 18: 24285
MORGAN, J. W., Uranium and Th abundances in stony meteorites. II., 18: 24286
MORI, Kiyohiko, Radiation-induced polymerization of vinyl acetate, 18: 23593 (AEC-tr-6316(p.134-6))
MORI, Kiyohiko, Radiation-induced polymerization of glyoxal, 18: 23600 (AEC-tr-6316(p.174-7))
MORI, Kiyohiko, Radiation-induced polymerization of acetone types, 18: 23601 (AEC-tr-6316(p.178-81))
MORI, Shigeyuki, Gamma irradiation of onion bulbs, 18: 23255
MORITZ, J., Spectrometry of fast neutrons with semiconductors, 18: 23884 (NP-13930(p.159-77))
MORRIS, Dale D., Conditioned aversion to saccharin using x rays as stimulus, 18: 23237 (FSU-2690-15(Paper 3))
MORRIS, Dale D., Conditioned aversion to saccharin using x rays produced by accelerator, 18: 23238 (FSU-2690-15(Paper 4))
MORRIS, Dale D., Conditioned aversion to saccharin using x rays as unconditioned stimulus, 18: 23239 (FSU-2690-15(Paper 5))
MORRIS, Dale D., Conditioned aversion to saccharin during post exposure period, 18: 23240 (FSU-2690-15(Paper 7))
MORRIS, Dale D., Effects of atropine sulfate and physostigmine on aversion to saccharin with x rays as stimulus, 18: 23236 (FSU-2690-15(Paper 2))
MORRIS, Kelso B., Electrical conductance and density in molten Mo(VI) oxide–alkali (Li, K) molybdate systems, 18: 23486
MORRISON, G. C., Nuclear reaction studies with Li ions on B-10 and B-11 targets, 18: 24720
MORRISON, John L., D-H exchange between H_2O and silk fibroin, 18: 23470
MORTON, John, Stabilizing devices for bodies located in a channel or bore, 18: 24870
MOSIN, A. F., Radioprotective properties of isothiuronic derivatives of pyridoxine, 18: 23364 (JPRS-24817(p.15-17))
MOSKVIN, L. N., Isolation of Se from SrO target irradiated with fast protons, 18: 23731
MOSKVIN, L. N., Separation of Eu from rare earths, 18: 23723
MOSTOVOI, V. I., Thermalizing properties of water and certain organic compounds, 18: 24566 (NP-13912)
MOSTOVOY, S., Strain softening to improve properties of refractory metals, 18: 24119 (AD-425148)
MOUNIB, M. Said, Effects of irradiation on metabolism of spermatozoa, 18: 23297
MOWAT, J. G., Production of two charged pions in 871-Mev π^--p interactions, 18: 24418
MOYER, Burton J., Elastic scattering of π^+ by protons, 18: 24453
MOYER, Burton J., Elastic scattering of π^- by protons, 18: 24454
MRKOS, A., Determination of the cosmic-ray equator, 18: 24329
MUCHNIK, M., Discrimination of low-energy protons in γ background, 18: 23929
MUCHNIK, M., Protective effects of Na sulfite on amidol developer, 18: 23554
MUELLER, Gerhard O., Programs available on Philco-2000 computer. I., 18: 24993 (KAPL-M-6139)
MUELLER, H. A., Light source for production of retinal burns, 18: 23254
MUELLER, W. J. C., Derivation of Boltzmann's equation. I., 18: 24507
MUKUNDA, N., Relativistically invariant position operators for spinning particles, 18: 24401 (NYO-10270)
MULFORD, R. N. R., Decomposition pressure of PuN, 18: 23482
MULLER, F., Production mechanism for reaction $K^+p \rightarrow K^+p$ at 3 Bev/c, 18: 24449
MULLER, J., Bulk superconductivity in dilute hexagonal Ti alloys, 18: 24553
MULLIN, C. J., High-frequency limit of bremsstrahlung spectrum, 18: 24426
MULYARCHIK, T. M., Geophysical investigations by means of Cosmos 3 and 5, 18: 24328
MULYARCHIK, T. M., Some characteristics of geoactive particles, 18: 24327
MUMM, John Frederick, Marine ship reactor, 18: 24946
MURAI, Yasuhisa, Theory of field in five-dimensional space, 18: 24510
MURAKAMI, K., Existence of extensive showers of primary γ radiation, 18: 24342
MURAV'EVA, I. A., Solubility of precipitated uranyl phosphates, 18: 23545
MURPHY, Charles, P_4S_3-cooled thermoelectric reactor plant, 18: 24902 (NP-13900(Sect.9))
MURRAY, G., Nuclear reaction studies with Li ions on B-10 and B-11 targets, 18: 24720
MUS, K. F., Quantometer having constant-sensitivity γ radiation above 15 Mev, 18: 23899
MUSETTE, Micheline, Linearization of differential scattering cross sections, 18: 24472
MUSIN, A. K., Role of diffusion and viscous friction in plasma acceleration, 18: 24795
MUTO, Y., Role of s-d exchange interactions in dilute alloys, 18: 24555
MUTSCHLER, Letitia E., Effect of EACA on deposition of radioiodinated fibrinogen, 18: 23219
MUZIKAR, C., Time modulation of recoilless nuclear resonance fluorescence, 18: 24228
MYAKISHEV, K. G., Influence of melt nature on formation of mixed crystals CaF_2–CeF_3 and CaF_2–YF_3, 18: 23533
MYLZEVA, V. A., Improvements for emulsions by incorporation of surface-active material, 18: 23495

N

NACHMAN, J. F., Vapor pressures of Sm and Gd, 18: 23439 (CONF-405-
NADUBOVICH, Ye. A., Geographic distribution of auroral arcs and bands, 18: 24523
NAGAI, Teruo, Studies with Se-75 methionine for diagnosis of pancreas tumor, 18: 23392
NAGIBAROV, V. R., Deformation cooling, 18: 24703
NAGY, K., Muon decay with two kinds of neutrinos, 18: 24405
NAGY, K., Pion decay, 18: 24406
NAKACHE, F. R., Minimum-weight proton shields, 18: 24805 (UNC-50
NAKAGAWA, Shigeru, Exposure dose by diagnostic x ray in obstetrics, 18: 23831
NAKAI, Eiichiro, Quantitative analysis utilizing isotopic exchange reaction, 18: 23430
NAKAI, Yota, Beta dosimetry by discoloration of PVC film, 18: 23894 (AEC-tr-6316(p.46-58))
NAKAI, Yota, Calorimetric determination of β flux, 18: 23893 (AEC-tr-6316(p.24-30))
NAKAI, Yota, Distribution of β energy dissipation in absorbers. I., 18: 24626 (AEC-tr-6316(p.35-41))
NAKAI, Yota, Distribution of β energy dissipation in absorbers. II., 18: 24627 (AEC-tr-6316(p.42-5))
NAKAI, Yota, Gamma absorption adjacent to scattering bodies. I., 18: 24217 (AEC-tr-6316(p.9-16))
NAKAI, Yota, Gamma absorption adjacent to scattering bodies. II., 18: 24218 (AEC-tr-6316(p.17-23))
NAKAI, Yota, Low-energy spectrum of β radiation, 18: 24628 (AEC-tr-6316(p.59-65))
NAKAI, Yota, Mean β energy distribution in absorbers, 18: 24219 (AEC-tr-6316(p.31-4))
NAKAJIMA, Yoshiharu, Heat treating and irradiating polyvinyl chloride, 18: 23398 (AEC-tr-6316(p.395-400))
NAKAJIMA, Yoshiharu, Radiation-induced reactions of polyvinyl chloride, 18: 23625 (AEC-tr-6316(p.381-94))
NAKAMOTO, Yasushi, Radioisotope renogram and clinical application, 18: 23393
NAKAMURA, Shigeki, Delayed neutron yield from U target bombarded by electrons, 18: 24574
NAKAMURA, Shigeki, Liquid flowing neutron monitor, 18: 23896
NAKAMURA, Shigeki, Short pulsing for linac. II., 18: 24254
NAKAMURA, Yoko, Graft polymerization of polyoxymethylene induced by radiation, 18: 23607 (AEC-tr-6316(p.223-5))
NAKAMURA, Yoko, Radiation-induced liquid-phase anionic polymerization, 18: 23591 (AEC-tr-6316(p.129-30))
NAKAMURA, Yoko, Radiation-induced polymerization of vinyl ether, 18: 23592 (AEC-tr-6316(p.131-3))
NAKAMURA, Yoko, Radiation-induced polymerization on γ alumina, 18: 23594 (AEC-tr-6316(p.137-44))
NAKAMURA, Yoko, Radiation-induced polymerization of compounds with

triple bonds, 18: 23596 (AEC-tr-6316(p.152-3))

NAKAMURA, Yoko, Radiation-induced polymerization of formaldehyde, 18: 23598 (AEC-tr-6316(p.163-7))

NAKAMURA, Yoko, Radiation-induced polymerization of acetone types, 18: 23601 (AEC-tr-6316(p.178-81))

NAKAMURA, Yoko, Radiation-induced polymerization of trioxane, 18: 23602 (AEC-tr-6316(p.182-5))

NAKAMURA, Yoko, Radiation-induced polymerization by ring cleavage, 18: 23606 (AEC-tr-6316(p.208-11))

NAKAMURA, Yoko, Structure of polymers formed by radiation-induced ring cleavage, 18: 24148 (AEC-tr-6316(p.212-16))

NAKANO, George H., Mirroring protons in South Atlantic anomaly, 18: 24515 (UCRL-11409)

NAKASIMA, Ryuzo, Distorted wave analysis of nuclear transfer reactions, 18: 24719

NAKAYA, Syojiro, Radioisotope renogram and clinical application, 18: 23393

NAMORADO ROSA, Rui, Radiolysis of pure water by 1- to 2-Mev protons. I. Steady beam, 18: 23578 (LFEN-15)

NARAIN, R., Canada India reactor operating experience, 18: 24949 (AEET/ROD/7)

NARASIMHAMURTY, H. V. L., Specific heat and emissivity of Ta, 18: 24122 (ASD-TDR-63-371)

NARATH, A., Continuous preparation of nuclear track emulsions, 18: 23494

NARATH, A., Grain growth in nuclear track emulsions, 18: 23493

NARGUND, P. K., 3-Alkyl-1,3-thiazane derivatives and precursors, 18: 23370

NASEDKIN, E. A., Isotopic exchange of H in hydrocarbons on rare earth oxides. II., 18: 23573

NATARAJAN, S., Effect of x-irradiation on posterior pituitary, 18: 23275

NATHANS, R., Magnetic moments and unpaired spin densities in Fe–Rh, 18: 24169

NATORI, Takeo, Radiation-induced polymerization on γ alumina, 18: 23594 (AEC-tr-6316(p.137-44))

NAUGLE, J. E., Application of nuclear emulsions to space research, 18: 23955

NAZARCHUK, M. M., Performance possibilities and operating experience with water/water reactor, 18: 24958 (NP-13907)

NAZIROV, N. N., Effects of γ radiation on cotton cell protoplasm, 18: 23300

NE'EMAN, Yuval, Internal symmetries, 18: 24379 (CONF-510-1)

NEFEDOV, V. D., Composition of Sb(V) phenyl derivatives during β decay of Sb-125, 18: 23694

NEFEDOV, V. D., Separation of As and Ge phenyl derivatives by partition chromatography, 18: 23733

NEFEDOV, V. D., Synthesis of tri-α-naphthylamine Te derivatives, 18: 23695

NEGANOV, B. S., Polarization of protons in single crystals of LaMg double nitrate, 18: 23444 (JINR-P-1626)

NEHREN, R., Physical properties of OM_2 for heat transfer purposes, 18: 23569 (EUR-1619.e)

NEILL, F. H., Graphite oxidation and mass transport test facility, 18: 23447 (ORNL-TM-831)

NEMETH, J., Ground-state energy of odd-fermion systems, 18: 24631

NEMIROVSKII, P. E., Optical model for antinucleon–nucleon collisions, 18: 24481

NEMKOVA, O. G., Solubility of precipitated uranyl phosphates, 18: 23545

NESHPOR, V. S., Shear moduli of silicides of transition metals, 18: 24174

NESTERIKHIN, Yu. E., Generation of superfast plasma bundles in linear accelerator, 18: 24775

NEUMANN, Kl. K., Free path length in air plasma, 18: 24773

NEUPERT, Werner M., Computation of an electron temperature, 18: 24278

NEWBOLT, W. B., Internal conversion studies in decay of Ag-110m, 18: 24738

NEWMAN, D. H., Zr–U processing equipment contamination and decontamination, 18: 23705 (ORNL-TM-837)

NEWMAN, E., Angular distribution of N-15 particles from $Al^{27}(O^{16},N^{15})Si^{28}$, 18: 24718

NEWMAN, E., Single-nucleon transfer excitation functions, 18: 24716

NEWTON, Amos S., Excess-kinetic-energy ions in organic mass spectra. I., 18: 25019 (UCRL-10823)

NGUEN, Din-Ty, Radiative resonance decays involving Λ hyperons, 18: 24387 (JINR-P-1615)

NICHUGOVSKII, G. F., Separation of alkali metals by electrophoresis. I., 18: 23729

NICHUGOVSKII, G. F., Separation of alkali metals by electrophoresis. II., 18: 23730

NICOLAE, M., Mechanism of sensitization of photographic emulsion by T.E.A., 18: 23552

NICOLAE, M., Possibility of reducing parasitic scattering in emulsions, 18: 23936

NICOLL, D. R., Organic scintillators and Cherenkov detectors, 18: 23975

NIGRO, M., Polarization of Λ° from $\gamma + p \rightarrow K^+ + \Lambda^\circ$, 18: 24428

NIKITIN, S. A., Ferro- and antiferromagnetism of rare earths, 18: 24178

NIKITINA, S. A., Hydrogen bond in alkyl amine salts. II., 18: 23577

NIKOLAEV, A. V., Extraction system $La(NO_3)_3$–HNO_3–H_2O–$(C_4H_9O)_3PO$ at 25°, 18: 23712

NIKOLAEV, A. V., Thermochemical study of $UO_2(NO_3)_2$–H_2O–TBP system, 18: 23713

NIKOLAEV, Yu. G., Structural changes and physical properties of reactor IRT-2000, 18: 24960 (NP-13911)

NIKOL'SKII, A. P., Geographical distribution of magnetic disturbances from auroras, 18: 24524

NIKOL'SKII, G. M., Temperature of the solar corona, 18: 24281

NIKOL'SKII, V. D., Synthesis of plutonyl carbonates, 18: 23538

NISHII, Masanobu, Radiation-induced liquid-phase anionic polymerization, 18: 23591 (AEC-tr-6316(p.129-30))

NISHII, Masanobu, Radiation-induced polymerization of vinyl ether, 18: 23592 (AEC-tr-6316(p.131-3))

NISHII, Masanobu, Radiation-induced polymerization of trioxane, 18: 23602 (AEC-tr-6316(p.182-5))

NISHII, Masanobu, Radiation-induced polymerization of β-propiolactone, 18: 23604 (AEC-tr-6316(p.190-4))

NISHII, Masanobu, Radiation-induced polymerization of mixed crystals, 18: 23605 (AEC-tr-6316(p.201-7))

NISHII, Masanobu, Radiation-induced polymerization by ring cleavage, 18: 23606 (AEC-tr-6316(p.208-11))

NISHII, Masanobu, Structure of polymers formed by radiation-induced ring cleavage, 18: 24148 (AEC-tr-6316(p.212-16))

NISHIMURA, Hitoshi, Excitation spectra of neutron irradiated ZnS: Cu phosphors, 18: 24575

NISHIO, Kazuo, Effect of Cs-137 and Sr-90 on mice. II., 18: 23210

NISHIO, Kazuo, Radiation-induced leukemia in mice. I., 18: 23256

NISHIO, Kazuo, Radioactive contamination of vegetables with fallout, 18: 23797

NISSEN-MEYER, R., Influence of ovarian irradiation on urinary estrogens in breast cancer patients, 18: 23346

NITTA, Isamu, Effect of addition of pigments to radiation behavior of polymers, 18: 24199 (AEC-tr-6316(p.359-67))

NITTA, Isamu, ESR spectra of irradiated polymers, 18: 23617 (AEC-tr-6316(p.310-13))

NITTA, Isamu, Heat treating and irradiating polyvinyl chloride, 18: 23398 (AEC-tr-6316(p.395-400))

NITTA, Isamu, Mechanisms of radiation chemistry reactions, 18: 23614 (AEC-tr-6316(p.283-94))

NITTA, Isamu, Radiation-induced oxidation of polyvinyl chloride, 18: 23623 (AEC-tr-6316(p.353-8))

NITTA, Isamu, Radiation-induced oxidation of polymers, 18: 23619 (AEC-tr-6316(p.322-5))

NITTA, Isamu, Radiation-induced oxidation of polyethylene, 18: 23620 (AEC-tr-6316(p.326-42))

NITTA, Isamu, Radiation-induced oxidation of polyethylene, 18: 23621 (AEC-tr-6316(p.343-5))

NITTA, Isamu, Radiation-induced oxidation of polypropylene, 18: 23622 (AEC-tr-6316(p.346-52))

NITTA, Isamu, Radiation-induced reactions of polyvinyl chloride, 18: 23625 (AEC-tr-6316(p.381-94))

NITTA, Isamu, Radicals formed by irradiation of polyethylene and polypropylene, 18: 23615 (AEC-tr-6316(p.295-305))

NITTA, Isamu, Radical production curve of irradiated polymers, 18: 23618 (AEC-tr-6316(p.314-21))

NITTA, Isamu, Radicals formed by irradiation of polypropylene, 18: 23624 (AEC-tr-6316(p.368-80))

NITTA, Isamu, Singlet ESR spectra when polymers are exposed to high

radiation flux, 18: 23616 (AEC-tr-6316(p.306-9))
NOGALES, R., Transistorization of neutron monitor, 18: 23966
NOHADANI, H., Cross section measurements on Pd for epithermal neutron energies, 18: 24609 (NP-13930(p.112-13))
NOONAN, Thomas R., Hematological effects of x irradiation in the rat, 18: 23296
NORBECK, E., Two-parameter analysis of Li reactions, 18: 24722
NORDYKE, Milo D., Crater nomenclature, 18: 25018 (UCRL-7750)
NORDYKE, Milo D., Cratering experience with chemical and nuclear explosives, 18: 23752 (UCRL-7793)
NORRIS, William P., Prog. rpt. on toxicity and metabolism of radionuclides, 6/63, 18: 23184 (ANL-6823(p.44-75))
NORSEEV, Yu. V., Separation of Au from chloride solutions, 18: 23718
NORTH, Donald Christopher, Jr., Marine ship reactor, 18: 24946
NORTHROP, D. C., Semiconductor counters for nuclear radiations, 18: 23969
NORWOOD, James M., Jr., Separation by liquid-liquid extraction, 18: 23739
NOTTER, G., Influence of ovarian irradiation on urinary estrogens in breast cancer patients, 18: 23346
NOVIKOVA, N. R., Properties of fine-grain nuclear emulsions, 18: 23498
NOWAK, W., Inelastic scattering factor for transitions in atoms, 18: 24307
NOWICKI, M., Window amplifier, 18: 23839 (PAN-479/I)
NOYES, Robert N., Heat transfer of rod matrices, 18: 23764 (APEX-724)
NUNAN, Craig S., Linear particle accelerator, 18: 24268
NURIEV, A. N., Leaching U and Ra from clays, 18: 23711
NUSSBAUM, M., Neutral decay and isotopic spin of the f^0, 18: 24463

O

OAKBERG, E. F., Species comparisons of radiation response of gonads, 18: 23323
OBERLIN, M., Oxidation of unirradiated and irradiated nuclear graphites, 18: 24202 (GA-tr-5174)
OBRYK, E., Electromagnetic properties of baryons in unitary symmetry model, 18: 24388 (JINR-P-1616)
OCHI, Hiroshi, Radiation-induced reaction between acetaldehyde and ethylene, 18: 23611 (AEC-tr-6316(p.253-60))
ODA, M., High-energy muon flux at sea level, 18: 24336
ODAN, Kenji, Electrical properties of polyacrylonitrile-formed radiation-induced polymerization, 18: 24149 (AEC-tr-6316(p.226-31))
ODAN, Kenji, Radiation-induced polymerization of acrylonitrile, 18: 23595 (AEC-tr-6316(p.145-51))
ODAN, Kenji, Radiation-induced polymerization of compounds with triple bonds, 18: 23596 (AEC-tr-6316(p.152-3))
ODAN, Yasuji, Effect of addition of pigments to radiation behavior of polymers, 18: 24199 (AEC-tr-6316(p.359-67))
ODINTSOVA, I. N., Effects of solar flares in ionosphere E and D layers, 18: 24283
O'DONNELL, P. J., Photodisintegration of deuteron, 18: 24416
OERTEL, G. K., Photons in magnetic fields, 18: 24289
OGAWA, Seiji, ESR absorption of irradiated alcohols, 18: 23649 (AEC-tr-6316(p.538-50))
OGIEVETSKII, V. I., Possibility of hypernuclei of large strangeness, 18: 24448
OGLOBIN, A. A., Search for light neutron nuclei, 18: 24616 (NP-13964)
OHNISHI, Tokuhiro, Discharge figures in dielectrics by electron irradiation. II., 18: 24203
OHNUMA, H., Elastic scattering of 55-Mev protons by heavy nuclei, 18: 24665
OJIMA, Tsutomu, Gamma and electron irradiation of clays and soils, 18: 23171
OJIMA, Tsutomu, Gamma irradiation of onion bulbs, 18: 23255
OJIMA, Tsutomu, Measuring tritiated H_2O in soils, 18: 23419
OKA, Takashi, Radiation-induced phase transition in ZnS, 18: 23665
OKABE, Shigeru, Backscattering of electrons in range 4 to 14 Mev, 18: 24409
OKABE, Shigeru, Delayed neutron yield from U target bombarded by electrons, 18: 24574
OKABE, Shigeru, Dose rate effect of chemical dosimetry with chloral hydrate, 18: 23663
OKABE, Shigeru, Liquid flowing neutron monitor, 18: 23896
OKABE, Shigeru, Secondary electron monitor for energies below 20 Mev. II, 18: 24253
OKABE, Shigeru, Short pulsing for linac. II., 18: 24254
OKADA, Kunio, Graft polymerizations of polyvinyl alcohol in air, 18: 23582 (AEC-tr-6316(p.70-5))
OKADA, Kunio, Graft polymerization of styrene on pre-irradiated cellulose, 18: 23586 (AEC-tr-6316(p.89-94))
OKADA, Norio, Gamma-induced graft polymerization of styrene on methanol, 18: 23581 (AEC-tr-6316(p.66-9))
OKADA, Norio, Gamma-induced graft polymerization of 2-methyl 5-vinyl pyridine and styrene, 18: 23584 (AEC-tr-6316(p.79-83))
OKADA, Norio, Gamma-induced graft polymerization of styrene, 18: 23585 (AEC-tr-6316(p.84-8))
OKADA, Norio, High-temperature irradiation of polyvinyl alcohol, 18: 24197 (AEC-tr-6316(p.114-17))
OKADA, Norio, IR absorption spectra of polyvinyl alcohol while being irradiated, 18: 23590 (AEC-tr-6316(p.121-8))
OKADA, Norio, Post heating of polyvinyl alcohol irradiated at room temperature, 18: 24198 (AEC-tr-6316(p.118-20))
OKADA, Norio, Radiation-induced graft polymerization of vinyl monomers on polyvinyl alcohol, 18: 23583 (AEC-tr-6316(p.76-8))
OKADA, Norio, Radiation-induced graftings on cellulose, 18: 23587 (AEC-tr-6316(p.95-9))
OKADA, Norio, Radiation-induced graft polymerization on polyethylene and polypropylene, 18: 23589 (AEC-tr-6316(p.105-13))
OKAMOTO, Shinichi, Discharge figures in dielectrics by electron irradiation. II., 18: 24203
OKAMOTO, Shinichi, Response of ionization chamber in pulsed beam, 18: 23897
OKAMURA, Seizo, Electrical properties of polyacrylonitrile-formed radiation-induced polymerization, 18: 24149 (AEC-tr-6316(p.226-31))
OKAMURA, Seizo, Graft polymerization of polyoxymethylene induced by radiation, 18: 23607 (AEC-tr-6316(p.223-5))
OKAMURA, Seizo, Radiation-induced liquid-phase anionic polymerization, 18: 23591 (AEC-tr-6316(p.129-30))
OKAMURA, Seizo, Radiation-induced polymerization of vinyl ether, 18: 23592 (AEC-tr-6316(p.131-3))
OKAMURA, Seizo, Radiation-induced polymerization of vinyl acetate, 18: 23593 (AEC-tr-6316(p.134-6))
OKAMURA, Seizo, Radiation-induced polymerization on γ alumina, 18: 23594 (AEC-tr-6316(p.137-44))
OKAMURA, Seizo, Radiation-induced polymerization of acrylonitrile, 18: 23595 (AEC-tr-6316(p.145-51))
OKAMURA, Seizo, Radiation-induced polymerization of unsaturated 5-membered ring compounds, 18: 23597 (AEC-tr-6316(p.154-62))
OKAMURA, Seizo, Radiation-induced polymerization of formaldehyde, 18: 23598 (AEC-tr-6316(p.163-7))
OKAMURA, Seizo, Radiation-induced polymerization of formaldehyde, 18: 23599 (AEC-tr-6316(p.168-73))
OKAMURA, Seizo, Radiation-induced polymerization of glyoxal, 18: 23600 (AEC-tr-6316(p.174-7))
OKAMURA, Seizo, Radiation-induced polymerization of acetone types, 18: 23601 (AEC-tr-6316(p.178-81))
OKAMURA, Seizo, Radiation-induced polymerization of trioxane, 18: 23602 (AEC-tr-6316(p.182-5))
OKAMURA, Seizo, Radiation-induced polymerization of β-propiolactone, 18: 23604 (AEC-tr-6316(p.190-4))
OKAMURA, Seizo, Radiation-induced polymerization of mixed crystals, 18: 23605 (AEC-tr-6316(p.201-7))
OKAMURA, Seizo, Radiation-induced polymerization by ring cleavage, 18: 23606 (AEC-tr-6316(p.208-11))
OKAMURA, Seizo, Radiation-induced polymerization of compounds with triple bonds, 18: 23596 (AEC-tr-6316(p.152-3))
OKAMURA, Seizo, Radiation-induced polymerization of diketene, 18: 23603 (AEC-tr-6316(p.186-9))
OKAMURA, Seizo, Structure of polymers formed by radiation-induced ring cleavage, 18: 24148 (AEC-tr-6316(p.212-16))
OKUDA, Yoshihiro, Calorimetric determination of β flux, 18: 23893 (AEC-tr-6316(p.24-30))
OLDFIELD, D. G., Chemical radioprotection against absorber-moderated protons, 18: 23357 (NP-13918(p.107-15))
OLDFIELD, D. G., Dose-mortality relationships for radioprotective agents,

18: 23355 (NP-13918(p.75-98))

OLDMSTED, John, III., Excess-kinetic-energy ions in organic mass spectra. I, 18: 25019 (UCRL-10823)

OLESEN, M. C., Coulomb excitation of vibrational states in deformed nuclei, 18: 24729

OLESEN, M. C., Reaction $C^{12}(C^{12},\alpha)Ne^{20}$, 18: 24724

OL'KHOVSKII, V. S., Polarization effect in neutron scattering on nuclei, 18: 24694

OLLERHEAD, R., Dissociation reactions in light nuclei, 18: 24723

OLSON, W. M., Decomposition pressure of PuN, 18: 23482

ONISHI, Shunichi, Effect of addition of pigments to radiation behavior of polymers, 18: 24199 (AEC-tr-6316(p.359-67))

ONISHI, Shunichi, ESR spectra of irradiated polymers, 18: 23617 (AEC-tr-6316(p.310-13))

ONISHI, Shunichi, Heat treating and irradiating polyvinyl chloride, 18: 23398 (AEC-tr-6316(p.395-400))

ONISHI, Shunichi, Mechanisms of radiation chemistry reactions, 18: 23614 (AEC-tr-6316(p.283-94))

ONISHI, Shunichi, Radiation-induced oxidation of polymers, 18: 23619 (AEC-tr-6316(p.322-5))

ONISHI, Shunichi, Radiation-induced oxidation of polyethylene, 18: 23620 (AEC-tr-6316(p.326-42))

ONISHI, Shunichi, Radiation-induced oxidation of polyethylene, 18: 23621 (AEC-tr-6316(p.343-5))

ONISHI, Shunichi, Radiation-induced oxidation of polypropylene, 18: 23622 (AEC-tr-6316(p.346-52))

ONISHI, Shunichi, Radiation-induced oxidation of polyvinyl chloride, 18: 23623 (AEC-tr-6316(p.353-8))

ONISHI, Shunichi, Radiation-induced reactions of polyvinyl chloride, 18: 23625 (AEC-tr-6316(p.381-94))

ONISHI, Shunichi, Radicals formed by irradiation of polyethylene and polypropylene, 18: 23615 (AEC-tr-6316(p.295-305))

ONISHI, Shunichi, Radical production curve of irradiated polymers, 18: 23618 (AEC-tr-6316(p.314-21))

ONISHI, Shunichi, Radicals formed by irradiation of polypropylene, 18: 23624 (AEC-tr-6316(p.368-80))

ONISHI, Shunichi, Singlet ESR spectra when polymers are exposed to high radiation flux, 18: 23616 (AEC-tr-6316(p.306-9))

ONLEY, D. S., Inelastic scattering of electrons by nuclei. III., 18: 24669

ONO, K., Elastic scattering of 55-Mev protons by heavy nuclei, 18: 24665

Ontiveros, F. Angel Garcia
see F. Angel Garcia Ontiveros

OPARIN, V. A., Dissociation of H_2^+ ions in collision with atoms and molecules, 18: 24324

ORAVEC, J., Generator of high-power pulses of nanosecond length, 18: 23843

ORDANYAN, S. S., Shear moduli of silicides of transition metals, 18: 24174

ORLOV, A. S., Structural changes and physical properties of reactor IRT-2000, 18: 24960 (NP-13911)

ORTIN, N., Radiochemical purity of solutions of phosphates and pyrophosphates, 18: 23417

OSHIMA, Keichi, Copolymerization of tetrafluoroethylene with isobutene induced by radiation, 18: 23685

OSTERBERG, Charles, Zinc-65 in euphausiids, 18: 23182

OSTERMANN, Friedrich G., Effects of annealing and grain size in powder-metallurgy W, 18: 24123 (ASD-TDR-63-676)

OSTROVSKII, E. K., Injection accelerator of electrons with constant phase velocity, 18: 24244 (NP-13908)

OTOBA, Hei, Electrolytic dissociation of aliphatic amines by β bombardment, 18: 23608 (AEC-tr-6316(p.232-7))

OTOKOZAWA, J., Analytic continuation of scattering amplitudes, 18: 24440

OTSUBO, Koji, ESR of carbon black, 18: 23401 (AEC-tr-6316(p.660-8))

OTSUBO, Koji, Graft polymerization of vinyl monomers, 18: 23657 (AEC-tr-6316(p.640-9))

OTTE, Henry M., Prog. rpt. rpt. on allotropic transformation in metals, final, 3/60–3/64, 18: 24994 (MND-2531-1)

OTWINOWSKI, A., SIUP geometrical reconstruction program, 18: 23887 (PAN-474/VI)

OUVAROVA, V. M., Hypersensitization of layers of emulsion for nuclear studies, 18: 23551

OUVAROVA, V. M., Methods for treating unsupported layers of emulsion, 18: 23926

OWENS, J. E., Initial operation of Hallam power facility, 18: 24878 (CONF-504-3)

OWENS, W. L., Jr., Pool boiling with reference to additives, 18: 23761 (AEEW-R-180)

OWERS, M. J., Radioactivities in bones, 18: 23402 (AERE-R-4466)

OZAWA, Lyuji, Emission characteristics of ZnS phosphors, 18: 23693

P

PAAKKOLA, O., Distribution of fallout products in milk, 18: 23800

PACE, H. B., Effects of continuous pre- and postnatal irradiation on reproduction in the albino rat, 18: 23343

PACE, Henry B., Effect of continuous radiation on reproductive capacity and fertility, 18: 23328

PACES, Jaroslav, Ultra-high-vacuum apparatus, 18: 24225

PADWA, L., STEAM—program to analyze spark chamber data, 18: 23872 (BNL-833)

PAGES, A., Four-channel digital commutator, 18: 23855

PAIC, M., Discrimination of protons and α particles by Ilford KO emulsions, 18: 23933

PAIC, V., Discrimination of protons and α particles by Ilford KO emulsions, 18: 23933

PAKHOMENKO, I. M., Restoration of homologous monkey heart cells following irradiation, 18: 23375

PAL, L., Antiferromagnetic-ferromagnetic transformation in FeRh, 18: 24166

PALEANI-VETTORI, P. G., Distribution of Na thiocyanate for tumor bearers exposed to irradiation. I., 18: 23285

PALL, F. A., Prediction of pressure vessel minimum fatigue life, 18: 24130 (D2-22437)

PALMER, Harvey E., Radioactivity measurements in Alaskan Eskimos in 1963, 18: 23834

PALMER, James F., Finding failed fuel in CANDU, 18: 24925

PALMER, Raymond W., Constant-velocity traveling magnetic wave plasma engine, 18: 24754 (NASA-TN-D-2278)

PANCHENKO, I. Ye., Calculation of skeleton activity by Sr-90 content of bones, 18: 23224

PANG, Shu-mei, Separation and analysis of rare earth elements, 18: 23709 (JPRS-24552(p.57-9))

PANG, Shu-wei, Separation of rare earth elements by chromatographic method, 18: 23715

PANKRATOV, V. M., Search for light neutron nuclei, 18: 24616 (NP-13964)

PANKRATZ, Louis B., Thermodynamic data for NbC, 18: 23435 (BM-RI-6446)

PAOLETTI, A., Polarized neutron investigation of Fe_3Si, 18: 24164

PAPPADEMOS, John, Low-energy Ξ-N interactions, 18: 24460

PAPPADEMOS, John, S-wave Λ-Λ interaction for odd Σ-Λ parity, 18: 24459

PARFENOV, L. B., Polarization of protons in single crystals of LaMg double nitrate, 18: 23444 (JINR-P-1626)

PARK, S. C., Nucleus-nucleus long-range interaction potential, 18: 24674

PARKE, Nathan Grier, III, Energy straggling in series of absorbing layers, 18: 24297 (AFCRL-63-558)

PARKER, A., Radioactivities in bones, 18: 23402 (AERE-R-4466)

PARKER, E. N., Perturbation of interplanetary dust grains by solar wind, 18: 24279

PARKER, R. G., Radiation cataract in clinical therapeutic radiology, 18: 23313

PARKINSON, Michael, Axiomatic approach to dimensions in physics, 18: 24221

PARKS, T. C., Non-stoichiometry in ternary rare-earth oxide systems, 18: 23509

PARLIER, B., Analysis of tracks created in Pb-plate spark chamber, 18: 23973

PARSONS, Thomas C., Remote pipetters for hot-cell enclosures, 18: 23842 (UCRL-9661)

PARTHASARATHY, R., Radio noise from auroral electrons. I., 18: 24537

PASECHNIK, M. V., Performance possibilities and operating experience with water/water reactor, 18: 24958 (NP-13907)

PASSARI, L., Polarized neutron investigation of Fe_3Si, 18: 24164

PATERA, I., Inelastic interactions of particles at high energies, 18: 24384 (JINR-P-1577)
PATOU, C., Determination of momentum of particles in emulsions, 18: 23945
PATTEN, Raymond A., Radiation effects on proteins and their constituents, 18: 23289
PATTERSON, D. R., Experimental Gas Cooled Reactor shaft seals, 18: 24914 (TID-7690(p.143-65))
PATTERSON, G. N., Mechanics of rarefied gases and plasmas, 18: 24764 (UTIAS-Rev-18)
PATTULLO, June, Zinc-65 in euphausiids, 18: 23182
PAVLOV, V. S., Vapor pressure of solid Y, 18: 24177
PAVLOVSKII, F. A., Ionizing ability of particles in spark chamber, 18: 24473
PAWLOWICZ, A. T., Electron-diffraction patterns from solid D, 18: 24558
PAXTON, H. C., Los Alamos critical-mass data, 18: 24349 (LAMS-3067)
PAZHIN, Yu. F., Neutron-neutron interaction in S-state, 18: 24398 (NP-13961)
PEACOCK, N. J., Emission-line profile measurements in transient plasmas, 18: 24791
PEARCY, William, Zinc-65 in euphausiids, 18: 23182
PEARSON, A., Computer for nuclear physics experiments, 18: 23858
PEARSON, C. A., Creation of deuterons from high-energy proton bombardment of matter, 18: 24664
PECKHAM, G., Focusing triple-axis spectrometer, 18: 23870 (AERE-R-4380)
PEGEL, B., Description and hydrodynamical approximation for classical plasma, 18: 24770
PEGG, T. G., Automatic processing and evaluation of film badge dosimeter, 18: 23818 (AWRE-O-93/63)
PELETMINSKII, S. V., Kinetic equations for plasma electrons and photons radiated by them in strong magnetic field, 18: 24765 (JPRS-24633 (p.43-61))
PELLERIN, P., Localization of consecutive activated zones after exposure to high neutron flux, 18: 23890 (SCPRI(S)-92)
PELLICCIONI, M., Measurements of fast neutrons by BF_3 proportional counter, 18: 23900
PELOSI, V., Detection of small angles of scattering, 18: 23947
PELUSO, R. F., Heats of solution of Pm, Nd, and Sm in liquid Sn, 18: 24183
PENNINGTON, E. M., Foil activation programs, 18: 23871 (ANL-6822)
PENNINGTON, Edwin M., Cylindrical lattice collision probability codes, 18: 24844 (ANL-6836)
PENNY, S. K., Inelastic effects in stripping and other direct reactions, 18: 24652
PENTZ, E. Irene, Determination of taurine in urine, 18: 25007 (TID-18929)
PENTZ, E. Irene, Excretion of taurine-S^{35} and sulfate-S^{35}, 18: 25006 (TID-18927)
PERELYGIN, V. P., Spontaneously fissioning isomer produced in reactions with charged particles, 18: 24725
PERETRUKHIN, V. F., Separation of Np-239 from irradiated U, 18: 23726
PEREZ-MENDEZ, Victor, Elastic scattering of π^- by protons, 18: 24454
PERFILOV, N. A., Characteristics of nuclear emulsions loaded with W, 18: 23920
PERFILOV, N. A., Discrimination of heavy ions in nuclear emulsion, 18: 23954
PERFILOV, N. A., Properties of fine-grain nuclear emulsions, 18: 23498
PERFILOV, N. A., Structure changes in tracks in developing nuclear emulsions, 18: 23924
PERKAS, M. D., Effects of alloying elements on strengthening of Fe–Ni martensites, 18: 24161
PERKINS, E. J., Biology of Solway Firth. III., 18: 23785 (PG-Report-577)
PERKINS, E. J., Biology of Solway Firth. XII., 18: 23180 (PG-Report-578)
PERKINS, R. B., Neutron-proton depolarization parameter, 18: 24393 (LADC-6357)
PERLMAN, I., STEAM—program to analyze spark chamber data, 18: 23872 (BNL-833)
PERLSTEIN, P., Isotope exchange in gaseous N under irradiation, 18: 23680
PERREAU, J. M., Production mechanism for reaction $K^+p \rightarrow K^+p$ at 3 Bev/c, 18: 24449
PERRIN, Henri, Shock relations in relativistic MHD, 18: 24227
PESIC, D. S., Green bands of $Mg^{24}O^{16}$ and $Mg^{26}O^{16}$ molecules, 18: 24316
PESSL, H. J., Irradiation effects on high-temperature reactor structural metals, 18: 24193 (HW-SA-3436)
PETER, G., Spin correlation coefficients in elastic 315-Mev scattering, 18: 24389 (JINR-P-1617)
PETERS, K. H., Distribution of fallout products in milk, 18: 23800
PETERSEN, J. S., Neutron resonance spectroscopy. III., 18: 24673
PETERSON, J. P., Jr., Prog. rpt. on nuclear burnup analyses, 9–11/63, 18: 24856 (GEAP-4430)
PETERSON, Peter J., Strontium-90 determination, 18: 23408 (NVO-162-8)
PETETTI, Inelastic scattering of neutrons on V hydride, 18: 24605 (NP-13930(p.59-71))
PETRENKO, V. V., Ionization energy losses by fast electrons in thin polystyrene layers, 18: 24702
PETRENKO, V. V., Linear electron accelerator up to 90 Mev, 18: 24245 (NP-13914)
PETRICK, E. N., Design and evaluation of perforated ion emitters, 18: 24366 (ASD-TDR-63-750)
PEVZNER, M. I., Research in nuclear and solid-state physics with research reactor IRT, 18: 24959 (NP-13910)
PEYRET, Roger, Structure of slow shock in two-fluid scheme with dissipation, 18: 24226
PFEIFER, V., Electrolytic U deposition on metals. I., 18: 23557
PFLUEGER, Margaret L., Index to conferences relating to nuclear science, 18: 25005 (TID-4043(Rev.1))
PFOHL, R., Interaction mechanisms of 200-Mev Ne-20 with Ag and Br nuclei, 18: 24732
PHILLIPS, K., Magnetohydrodynamic generation of power, 18: 24374
PHIPPS, Rupert, Material and design considerations in PM-1 vessel, 18: 24897 (NP-13900(Sect.2))
PI, Kee-ho, Absorption spectrum of Ce^{3+} in silica and borax glass, 18: 23459 (JPRS-24593(p.37-41))
PIERAGOSTINI, F., Pre-precipitation rate in Al–Zn alloy, 18: 24206
PILET, Paul-Emile, Effect of radiation on cytoplasmic movement, 18: 23274
PILIPETS, D. T., Performance possibilities and operating experience with water/water reactor, 18: 24958 (NP-13907)
PING, Heng-tieh, Solubility of precipitated uranyl phosphates, 18: 23545
PINKERTON, D. M., Hydride ion transfer and radiolysis in pentane and isopentane, 18: 23677
Pinto, A. A. Teixeira
  see Teixeira Pinto, A. A.
PIPER, John, Electrical properties of transition-metal carbides and nitrides, 18: 24137 (NP-13944)
PIRVU, M., Possibility of reducing parasitic scattering in emulsions, 18: 23936
PISAREV, A. F., Spin correlation coefficients in elastic 315-Mev scattering, 18: 24389 (JINR-P-1617)
PITAEVSKII, L. P., Recombination coefficient in dense low-temperature plasma, 18: 24801
PITCOCK, James A., Late testicular lesions in irradiated monkeys, 18: 23330
PITMAN, R. W., Water treatment at Hanford, 18: 23443 (HW-77710)
PLACE, Gerald A., Effect of soil moisture and Rb concentration on Rb-86 uptake, 18: 23227
PLASIL, Franz, Fission barrier of Tl-201, 18: 24670
PLATT, A. M., Prog. rpt. on solidification of radioactive wastes, 9/62-3/63, 18: 24975 (HW-81829)
PLATZMAN, P. M., Light-off-light scattering in a plasma, 18: 24788
PLENDL, H. S., Measurement of (n,γ) cross sections and resonance integrals, 18: 24608 (NP-13930(p.110-11))
PLESSET, Milton S., Effect of compressibility on stability of fluid interfaces, 18: 24999 (RM-3953-AEC)
PLEVE, A. A., Spontaneously fissioning isomer produced in reactions with charged particles, 18: 24725
PLOTNOV, G. F., Isolation of carrier-free radioactive Ce from fission products, 18: 23727
PLZAK, V., Chemical radioprotection against absorber-moderated protons, 18: 23357 (NP-13918(p.107-15))
PLZAK, V., Dose-mortality relationships for radioprotective agents, 18: 23355 (NP-13918(p.75-98))
PLZAK, V., Influence of chemical compounds on radiation lethality in

mice, 18: 23354 (NP-13918(p.58-74))
POCSIK, G., Field-theoretical method in theory of superconductivity, 18: 24545
POENITZ, W., Determination of absolute thermal neutron flux by Au foils, 18: 23876 (KFK-180)
POENITZ, W., Karlsruhe Van de Graaff project for fast neutrons, 18: 24246 (NP-13930(p.137-8))
POGORELOV, V. I., Streams of corpuscular radiation in auroral zones, 18: 24532
POHL, S. W., Particle disintegration study for re-entering NAP systems, 18: 24933 (AFSWC-TDR-63-51)
POLACKI, Z., Increase in radioluminescence efficiency, 18: 23662
POLACZEK, Andrzej, Electrical conductivity of Al(III), Ga(III) and In(III) iodides in alkyl iodides, 18: 23449 (PAN-491/V)
POLAK, J. A., Analysis of nucleon transfer data, 18: 24618 (NYO-1807-8)
Poli, G. Castellani
see Castellani Poli, G.
POLI, G. Castellani, Calibration of encapsulated Ra sources, 18: 23387 (ISS-64/2)
POLIKANOV, S. M., Spontaneously fissioning isomer produced in reactions with charged particles, 18: 24725
POLLARD, J. P., Neutron slowing-down spectra in Be and BeO, 18: 24576
POLTORATSKII, V. I., Cathodic sputtering of W by means of K ions, 18: 24776
POMERANCHUK, I. Ya., Peculiarities of partial waves near J = I and asymptotics of amplitude of elastic scattering, 18: 24395 (NP-13872)
POMRANING, G. C., Spherical harmonics approximation to the neutron transport equation, 18: 24573
PONOMAREV, E. A., Ultra-low-frequency auroral radiation, 18: 24521
PONOSOV, A. K., Absorption of slowed-down π^- mesons in propane, 18: 24475
POOL, M. J., Heats of solution of Pm, Nd, and Sm in liquid Sn, 18: 24183
POPLAVKO, M. V., Welding of Ti alloys, 18: 24106 (JPRS-24521(p.1-58))
POPOV, D. K., Radiochemical determination of Sb-125 in soils, 18: 23431
POPOV, V. V., Experimental, radiation-induced cataract in frogs, 18: 23268
POPOVA, A. M., Four- and five-particle production in high-energy encounters, 18: 24478
POPOVA, L. G., Results obtained with emulsions in magnetic field, 18: 23946
POPOVA, O. M., Effect of preliminary x irradiation on susceptibility of white mice to ornithosis virus, 18: 23248 (JPRS-24696)
POPOVICI, Andrei, Conform separation of spin states of particles, 18: 24410
PORTE, A., Modifications in mice renal tubes treated with uranyl nitrate, 18: 23214
PORTNOVA, S. I., Investigations of γ-quanta, produced in interactions of π^--mesons with nucleons and nuclei at $\approx$7 Bev, 18: 24391 (JINR-P-1629)
POTAPOV, B. P., Some characteristics of geoactive particles, 18: 24327
POTENZA, G., Discrimination of low-energy protons in γ background, 18: 23929
POTENZA, G., Photofission of Bi, W, and Ag, 18: 24655
POTENZA, G., Protective effects of Na sulfite on amidol developer, 18: 23554
POTTIER, Paul, Precipitation of uranium oxide, 18: 23436 (CEA-R-2414)
POUBEAU, P., Results at Strasbourg in stripping, etc., for high-energy studies, 18: 23941
POULSEN, N. O. R., Reaction $C^{12}(C^{12},\alpha)Ne^{20}$, 18: 24724
POWELL, H. M., Producing supersonic high electron density plasma, 18: 24743 (ANL-6802(p.29-36))
POWER, Geoffrey, Reciprocal relations in rotational MGD flow, 18: 23778
PRATS, M., Hot critical pile CESAR, 18: 24968
PRAVEDNIKOV, A. N., Gas evolution and double bonds during PIB radiolysis, 18: 23669
PREOBRAZHENSKII, B. K., Properties of sulfostyrene cation exchange resins, 18: 23736
PREOBRAZHENSKII, B. K., Separation of Au and Tl from a complex mixture by partition chromatography, 18: 23732
PRESKITT, C. A., Reactor transients accompanying pulsed source operation, 18: 24851 (ORNL-TM-570)
PREVALOV, G. F., Sensitivity of tree seed to radiation, 18: 23312
PRICE, P. B., Uranium contents of ancient man-made glass, 18: 23547
PRICE, P. Buford, Fission barrier of Tl-201, 18: 24670
PRIGOGINE, I., General theory of transport processes. II., 18: 24231
PRINCE, J. R., Effect of radiation on spermatozoan metabolism, 18: 23334
PROKHOVNIK, S. J., Cosmological model of light propagation, 18: 24543
PROKOPENKO, L. G., Protective effect produced by bacterial antigens in acute radiation sickness, 18: 23360 (JPRS-24704(p.1-5))
PROKOSHKIN, Yu. D., Production of π mesons in 650-Mev pp collisions, 18: 24476
PROSZYNSKA, Krystyna, Adsorption of H^+ and OH^- ions on Ni and Al, 18: 23448 (PAN-466/V)
PROTASOV, V. S., Crystal structures of Sc compounds with transition metals, 18: 24157
PROTOPOPOV, A. N., Angular and energy characteristics of fission-neutron emission of U-235, 18: 24697
PROUT, William E., Removal of Cs from evaporator condensate, 18: 23700 (DP-876)
PRUSAK, J. J., Prog. rpt. on thermodynamics of U–N system, annual, 1/64, 18: 23454 (UNC-5077)
PUGH, Santo, Luminescent phenomena and zirconia research, 18: 23661 (UCRL-Trans-1048(L))
PUGNETTI, G., Rapid separation of Np-239 and Pa-233, 18: 23409 (RT/CHI(63)-31)
PUKHAL'SKAYA, E. Ch., Effects of serotonin on hematopoietic system in irradiated rats, 18: 23376
PUNKKINEN, Matti, Quadrupole splitting in NMR of Na-23 in $NaClO_4$, 18: 23464
PURKAYASTHA, B. C., Coseparation of Th with Ca oxalate, 18: 23714
PURSEY, D. L., Foldy-Wouthuysen transformation for particles of arbitrary spin, 18: 24494
PUSHKAREV, V. V., Separating Sr-90 and Y-90 by means of gelatin foam, 18: 23735
PUSHLENKOV, M. F., Complexing of Am with acidic P organic compounds, 18: 23719
PUSTOVOIT, V. I., Gyroscope motion in gravitation theories, 18: 24511
PUZAKO, V. D., Separating Sr-90 and Y-90 by means of gelatin foam, 18: 23735
PUZANOV, V. V., Laboratory measuring-registering center, 18: 23861
PYASETSKAYA, O. V., Photometric equivalent of blackening produced by light and radiation, 18: 23914
PYLE, Robert V., Collisional electron detachment from 20-Mev D^0 and D^- ions, 18: 24310

Q

QUANDALLE, P., Intravenous injections of Guerin epithelioma. VI., 18: 23264
QUEIROLO, G. T., Rehomogenization kinetics of irradiation-segregated Cu–Ni, 18: 24208
QUINTELLA, S. G., Extended surface thermionic converters, 18: 24361 (ANL-6802(p.144-51))
QUITTET, A. M., Point-by-point study of surface of crystal, 18: 25035 (UCRL-Trans-1055(L))
QUITTNER, G., Suppression of reflections in rotating-crystal spectrometer, 18: 23880 (NP-13930(p.127))

R

RABB, David D., Contained nuclear explosions for evaluation of mining applications, 18: 23751 (UCRL-7350)
RABY, T. M., Zero power experiments for SM-1 Core III, 18: 24873 (ACNP-64517(Rev.1))
RAEVA, N. V., Therapeutic effects of procaine in acute radiation sickness, 18: 23384
RAGO, A. L., ELMOE—program treating elastic scattering in reactors, 18: 24811 (ANL-6805)
RAHMAN, A., Triplet correlations in liquids, 18: 24311
RAI, K. S., Effects of x irradiation on *Aedes aegypti*, 18: 23262
RAINEY, W. T., Jr., Kinetics of thermal decomposition of biphenyl, 18: 23570 (ORNL-3602)
RAINWATER, J., Neutron resonance spectroscopy. III., 18: 24673
RAKHIMOV, R. R., Energy distribution of electrons ejected by Ne atoms and

ions, 18: 24318
RAMASWAMY, M. K., Lifetime measurements in Sb-121, 18: 24683
RAMASWAMY, S., Electronic equipment at CIR, 18: 24948 (AEET/ROD/6)
RANGASWAMY, S., Study of equatorial spread-F, 18: 24535
RANON, U., Paramagnetic resonance of Yb^{3+} in $CaWO_4$, 18: 23525
RAO, C. S. R., Sporadic-E and the equatorial electrojet, 18: 24541
RAO, V. Surya, Commissioning of nuclear reactors, 18: 24810 (AEET/ROD/10)
RAO, V. Surya, Organization and administration of reactor operations, 18: 24950 (AEET/ROD/9)
RAPPENEAU, J., Oxidation of unirradiated and irradiated nuclear graphites, 18: 24202 (GA-tr-5174)
RASULOV, F. K., Effect of γ rays on sterility of cotton moth *(Laphygma exigua)*, 18: 23283
RATCLIFFE, C. A., Annunciator for a reactor automatic controller, 18: 24887 (HW-80921)
RATNER, B. S., Cross section for photoproton emission from Cu, 18: 24698
RATTERMAN, E., Dynamics of P-140 reactor mockup, 18: 24936 (APEX-636)
RAUB, Christoph, Superconductivity of noble metals and alloys, 18: 24179
RAVICH-SHCHERBO, M. I., Protective effect produced by bacterial antigens in acute radiation sickness, 18: 23360 (JPRS-24704(p.1-5))
RAWITSCHER, G. H., Nonrelativistic limit of Coulomb scattering, 18: 24500
RAWITSCHER, G. H., Nucleus-nucleus long-range interaction potential, 18: 24674
RAWSON, Donald E., Crater nomenclature, 18: 25018 (UCRL-7750)
RAYMUND, M., Loading of emulsion stacks with aqueous solutions, 18: 23919
RAZORENOV, L. A., Controlled exposure of nuclear emulsions on sputniks, 18: 23957
RAZORENOV, L. A., Cosmic rays and radiation belts, 18: 24347
RAZUMOVSKAYA, L. P., Observation of unstable regime during transition from weak to strong h-f discharge, 18: 24784
READY, T. J., Co-extrusion of refractory metal clad fuel elements, 18: 24101 (LAMS-3065)
REALE, A., Forward production of photons from 9-Bev π-p interactions, 18: 24417
RECHENMANN, R., Quantitative energetic comparison between traces, 18: 23910
REDDI, M. M., Fire simulation in shipping container studies, 18: 23827 (NYO-2539-1)
REHFELD, Carl E., Prog. rpt. on toxicity and metabolism of radionuclides, 6/63, 18: 23184 (ANL-6823(p.44-75))
REITER, F., Physical properties of OM_2 for heat transfer purposes, 18: 23569 (EUR-1619.e)
REMILLARD, G., Rapid iodination of human growth hormone with I-131, 18: 23225
RENOUF, T. J., Measurement of volume diffusion by autoradiography, 18: 23522
RENZ, A., High-purity Ge—surface conduction and carrier life, 18: 25030 (ORNL-tr-120)
RESEGOTTI, L., Synchronization between 300-Bev synchrotron and its booster injector, 18: 24240 (CERN-64-20)
RESIBOIS, P., General theory of transport processes. II., 18: 24231
REUTER, B., Karlsruhe Van de Graaff project for fast neutrons, 18: 24246 (NP-13930(p.137-8))
REVINA, A. A., Free-radical reactions during interaction of O with irradiated palmitate, 18: 23670
REYNOLDS, J. T., Inelastic scattering of electrons by nuclei. III., 18: 24669
REZANKA, I., Radioactive decay of Ni-65, 18: 24639
RHODES, D. N., Storage of radiation-sterilized meats, 18: 23271
RICCI, Enzo, Second-order interference in activation analysis, 18: 23428
RICH, J. B., Gas bubble growth on heating irradiated U, 18: 24187 (AERE-R-2935)
RICHARDS, Hans K., Thermionic energy conversion for d-c output, 18: 24362 (ANL-6802(p.152-60))
RICHARDSON, K. A., Alpha-activity at 4.4 Mev in natural Th, 18: 23802
RICHT, A. E., Postirradiation evaluation of stainless steel-clad plate-type specimens, 18: 24195 (ORNL-TM-815)
RIDER, B. F., Prog. rpt. on nuclear burnup analyses, 9–11/63, 18: 24856 (GEAP-4430)
RIDINGS, Alex, Experimental Gas Cooled Reactor shaft seals, 18: 24914 (TID-7690(p.143-65))
RIECK, H. G., Monitor for As-76 concentrations in reactor cooling water, 18: 24821 (HW-75374)
RIEDEL, G., Nuclear track preparations for electron microscope, 18: 23845
RIENECKER, F., Jr., Safety analysis for Super Kukla Prompt Burst Reactor, 18: 24964 (UCRL-7695)
RIGDON, Lester P., Titration of boric acid in aqueous solution, 18: 23412 (UCRL-7756)
RINDERER, Leo, Superconductor resonators in metric wave, 18: 24559
RINZIVILLO, R., Discrimination of low-energy protons in γ background, 18: 23929
RINZIVILLO, R., Photofission of Bi, W, and Ag, 18: 24655
RINZIVILLO, R., Protective effects of Na sulfite on amidol developer, 18: 23554
RIPFEL, H., Rotating-crystal spectrometer for scattering experiments with slow neutrons, 18: 23879 (NP-13930(p.126))
RIPLING, E. J., Strain softening to improve properties of refractory metals, 18: 24119 (AD-425148)
RISLEY, Paul L., Effects of radiation and isotope studies on male accessory sex organs, 18: 23336
RISTI, Harold A., Unit cell homogenization for reactor depletion studies, 18: 24861 (WCAP-6060)
RIVEST, Roland, Coordination complexes of group(IV) halides, 18: 23471
RIVET, E. J-M., Scattering of 65-Mev He ions from O-16, 18: 24623 (UCRL-10727)
ROBERTS, A., Spark chambers: state of the art, 18: 23971
ROBERTS, John D., Nitrogen-15 magnetic resonance spectroscopy. I., 18: 23530
ROBINSON, Press L., Electrical conductance and density in molten Mo(VI) oxide—alkali (Li, K) molybdate systems, 18: 23486
ROBINSON, R. A., Thermodynamics of DCl in D_2O, 18: 23484
ROCHE, M. R., Classical metrology in physical tests of reactors, 18: [illegible]
ROCK, Harvey Raymond, Marine ship reactor, 18: 24946
RODIONOV, V. M., Comparisons of albumen and α_2 globulin sera isolated before and after irradiation, 18: 23306
RODWELL, William, Nuclear reactors, 18: 24843
ROE, B., Evidence that the f^0 has isotopic spin zero, 18: 24466
ROESSLE, E., Neutron interaction cross sections on Si, 18: 24600 (NP-13930(p.39-40))
ROGACHEVSKAYA, Z. M., Constitution diagrams of metal systems. VI., 18: 24180
ROGACHEVSKAYA, Z. M., Constitution diagrams of metal systems. VII., 18: 24181
ROGAN, Harold, Improvements in or relating to welding, 18: 24113
ROGERS, R., Activity induced in food by irradiation, 18: 23815 (AERE-R-4601)
ROGOZINA, E. M., Processes and reaction products of high-molecular-weight compounds with inorganic salts. III., 18: 23542
ROHMER, Raymond, Preparation and study of uranyl and U(IV) salts, 18: 23473
ROHR, G., Karlsruhe Van de Graaff project for fast neutrons, 18: 24246 (NP-13930(p.137-8))
ROHSENOW, Warren M., Heat transfer during film condensation of liquid metal vapor, 18: 23768 (MIT-2995-1)
ROINISHVILI, V. N., Mechanism of operation of track spark chambers, 18: 23968
ROLLAND, P., Plasma instabilities, 18: 24780
ROMANI, R. J., Oxygen-dependent postirradiation restoration of *Rhizopus stolonifer* sporangiospores, 18: 23288
ROMANOV, G. A., Complexing of U(IV) with halide, sulfate, and perchlorate anions, 18: 23534
ROMANOVSKAYA, K. M., Moisture influence on the stability of emulsions, 18: 23922
ROMER, W., Controlled Ostwald maturing of photographic emulsions, 18: 23491
ROMNEY, E. M., Reducing volume of low-level radioactive waste, 18: 24986
ROOT, M., Influence of chemical compounds on radiation lethality in mice,

18: 23354 (NP-13918(p.58-74))
ROPP, R. C., Dynamic decomposition of rare-earth oxalates, 18: 23507
ROS, Joaquin, Uranium content of western Mediterranean, 18: 23787
Rosa, Rui Namorado
see Namorado Rosa, Rui
ROSE, G. V. M., Spectrum of gaseous ScF, 18: 23531
ROSE, M. E., Nuclear orientation, 18: 24706
ROSENBERG, Leonard, Distorted-wave Born expansions, 18: 24502
ROSENTHAL, Marcia W., Plutonium removal. VII., 18: 23350 (ANL-6823(p.105-8))
ROSENTHAL, Marcia W., Plutonium removal. V., 18: 23351 (ANL-6823 (p.114-15))
ROSENTHAL, Marcia W., Plutonium removal. VIII., 18: 23189 (ANL-6823(p.109-10))
ROSENTHAL, Marcia W., Plutonium removal. IX., 18: 23190 (ANL-6823 (p.111-13))
ROSHAL, A. S., Space-charge fast wave noise removal by resonator, 18: 23848
ROSS, Malcolm, Crystal chemistry of Be, 18: 23502
ROSS, Marc, Quantum scattering theory, 18: 24512
ROSS, P. A., Spectrum of gaseous ScF, 18: 23531
ROSSI, A., Utilization of Avogadro RIS reactor, 18: 24972
ROSUMNY, M. R., Radiography of C and graphite, 18: 24146 (WADD-TR-61-72(Vol.XVII))
ROTONDI, E., Measurements of fast neutrons by BF, proportional counter, 18: 23900
ROTTER, I., Coupling between shell model excitations and cluster excitations in light nuclei, 18: 24588 (JINR-P-1595)
ROUGGE, Pierre, Moderator structure for a nuclear reactor, 18: 24838
ROWAN, J. H., X-ray fluorescence tables for topaz crystal, 18: 24216 (Y-1470-B)
ROWLINSON, J. S., Study of intermolecular potential and virial functions, 18: 23560
RSUINOV, A. I., Ferromagnetism in superconducting alloys, 18: 24561
RUBEN, Helena, Crystal structure of Mg sulfate hexahydrate, 18: 25020 (UCRL-10832)
RUBIN, R., Inelastic scattering of neutrons on V hydride, 18: 24605 (NP-13930(p.59-71))
RUBISZ-BRZEZINSKA, Jozefa, Influence of ionizing rays on serum-resistant syphilis, 18: 23391
RUCKWIED, Armin, Strengthening of neutron-irradiated Cu single crystals, 18: 24200 (ANL-Trans-19)
RUCKWIED, Armin, Work hardening of neutron-irradiated Cu single crystals. II., 18: 24211
RUDAKOV, V. P., Search for light neutron nuclei, 18: 24616 (NP-13964)
RUDNICK, A., Refractory ceramics of interest in aerospace structural applications, 18: 24141 (RTD-TDR-63-4102)
RUEFENACHT, Jack, Superconductor resonators in metric wave, 18: 24559
RUFFIN, R. S., Light source for production of retinal burns, 18: 23254
RUGH, Roberts, Ionizing radiations and reproductive capacity, 18: 23324
RUIZ, C. P., Prog. rpt. on nuclear burnup analyses, 9–11/63, 18: 24856 (GEAP-4430)
RUIZ, J. A., Measurement of atmospheric radioactivity in Chacaltaya, 18: 23803
RUKHADZE, A. A., Geometric optics in electrodynamics of inhomogeneous plasma, 18: 24799
RUSEK, V., Separating elements of alkaline earth group on ion exchangers, 18: 23421
RUSSELL, Edwin R., Removal of Cs from evaporator condensate, 18: 23700 (DP-876)
RUSSELL, J. E., Fission cross section of Pu-241, 18: 24586 (IDO-16976)
RUSSELL, Lewis Eric, Plutonium compounds, 18: 23521
RUSSELL, R. B., Prog. rpt. on U–Al–Fe constitution diagram, 18: 24135 (NMI-2812)
RUSSELL, W. J., Deformities possibly due to thalidomide, 18: 25010 (TID-19257)
RUTKOWSKI, Wladyslaw, Control rods with sintered boron carbide, 18: 24974
RYABOVA, R. V., Chemical ripening of R emulsion, 18: 23497
RYAN, James W., Measurement of nn singlet S-state scattering length, 18: 24462
RYBCHINSKII, Iu., Impossible to conceal an atomic explosion, 18: 23805 (UCRL-Trans-1037(L))
RYDKII, S. G., Disruption of plant metabolism caused by treating seeds with radioactive substances, 18: 23205 (JPRS-24290(p.36-42))
RYSS, Ye. I., Regeneration of sciatic nerve in acute radiation sickness, 18: 23250 (JPRS-24704(p.12-17))
RYTOV, S. M., Synchrotron theory. Particle interactions in bunches, 18: 24265
RYZHENKOV, V. E., Neuro-endocrine reaction to mercamine and antiffeine and irradiation, 18: 23377

S

SABEL, C. S., Bibliography on containment of plasma, 18: 24748 (CLM-Bib-4)
SACHS, M., Boron-induced transfer reaction studies, 18: 24715
SADIKOV, I. P., Thermalizing properties of water and certain organic compounds, 18: 24566 (NP-13912)
SAFONOV, G., Prog. rpt. on fission-electric cell project, final, 1963, 18: 24372 (TID-20575)
SAFONOV, George, Fission-electric cell project, 18: 24371 (RM-3908-PR)
SAHININ, Frederick, X-irradiation effects on reproductive function in female hamster, 18: 23344
Said Mounib, M.
see Mounib, M. Said
ST-PIERRE, L., Ionographic study of reactions of neutrons on C, 18: 24642
SAITEEVSKY, B., Design of reactor complex and loading mechanism, 18: 24919 (ORNL-tr-82)
SAITO, Masanichi, Radioisotope renogram and clinical application, 18: 23393
SAKAMOTO, Masahiro, Radiation-induced polymerization of formaldehyde, 18: 23599 (AEC-tr-6316(p.168-73))
SAKURADA, Ichiro, Gamma-induced graft polymerization of styrene on methanol, 18: 23581 (AEC-tr-6316(p.66-9))
SAKURADA, Ichiro, Gamma-induced graft polymerization of 2-methyl 5-vinyl pyridine and styrene, 18: 23584 (AEC-tr-6316(p.79-83))
SAKURADA, Ichiro, Gamma-induced graft polymerization of styrene, 18: 23585 (AEC-tr-6316(p.84-8))
SAKURADA, Ichiro, Graft polymerizations of polyvinyl alcohol in air, 18: 23582 (AEC-tr-6316(p.70-5))
SAKURADA, Ichiro, Graft polymerization of styrene on pre-irradiated cellulose, 18: 23586 (AEC-tr-6316(p.89-94))
SAKURADA, Ichiro, High-temperature irradiation of polyvinyl alcohol, 18: 24197 (AEC-tr-6316(p.114-17))
SAKURADA, Ichiro, IR absorption spectra of polyvinyl alcohol while being irradiated, 18: 23590 (AEC-tr-6316(p.121-8))
SAKURADA, Ichiro, Post heating of polyvinyl alcohol irradiated at room temperature, 18: 24198 (AEC-tr-6316(p.118-20))
SAKURADA, Ichiro, Radiation-induced graft polymerization of vinyl monomers on polyvinyl alcohol, 18: 23583 (AEC-tr-6316(p.76-8))
SAKURADA, Ichiro, Radiation-induced graftings on cellulose, 18: 23587 (AEC-tr-6316(p.95-9))
SAKURADA, Ichiro, Radiation-induced graft polymerization on polyethylene and polypropylene, 18: 23589 (AEC-tr-6316(p.105-13))
SAKURAI, Akira, Transient heat transfer in heterogeneous water reactor. II., 18: 23776
SALA, A., Control of reactor Siloe, 18: 24966
SALESSE, Marc, Improvements in fuel element castings, 18: 24869
SALIMOV, M. A., Thorium acetates, 18: 23543
SALMON, M. A., Prog. rpt. on reactor containment, 2–4/64, 18: 24824 (TID-20613)
SALVADOR, Jack G., Video track analysis, 18: 23939
SAMELSON, Harold, Stimulated emission processes in rare earth chelates, 18: 24229
SAMOILOV, O. Ya., Solubility of gypsum in solutions of La, Pr, Nd, and Sm chlorides, 18: 23536
SAMOYLOVICH, D. M., Chemical ripening of R emulsion, 18: 23497
SAMOYLOVICH, D. M., Development of nuclear emulsion in electrodialyzer, 18: 23927
SAMOYLOVICH, D. M., Possibility of nuclear emulsion having changing sensitivity, 18: 23923
SAMOYLOVICH, D. M., Structure and size of centers in R emulsion, 18: 23913

SANCHO, J., Reversible and irreversible processes on dropping Hg electrode. XVIII., 18: 23463
SANDBERG, A., Effect of 2-mercaptoethylamine or para-aminopropiophenone in diets of irradiated mice, 18: 23358 (NP-13918(p.116-28))
SANDERS, J. E., Buckling and reaction rates in Pu–graphite assemblies, 18: 24852
SANFORD, P. W., Pulse-shape discrimination in proportional counters, 18: 23974
SANGIUST, V., Instability phenomena in operation of L54M reactor of CESNEF, 18: 24971
SANKOVICH, Melvin Francis, Marine ship reactor, 18: 24946
SANTHOLZER, Vilem, Atmospheric fallout in years 1962-63, 18: 23798
Santos, Manuel Lima e
see Lima e Santos, Manuel
SARAPH, H. E., Cross sections for n → n + 1 transitions in H, 18: 24314
SARAPUL'TSEV, I. A., Calculation of skeleton activity by Sr-90 content of bones, 18: 23224
SARGENT, Wallace L. W., Studies of the peculiar A stars. II., 18: 24274
SATCHLER, G. R., Distorted-wave theory of stripping reactions, 18: 24667
SATCHLER, G. R., Elastic and inelastic scattering of C from C, 18: 24710
SATCHLER, G. R., Inelastic effects in stripping and other direct reactions, 18: 24652
SATCHLER, G. R., Pickup of heavy clusters, 18: 24714
SATCHLER, G. R., Reaction (d,He^3) on Ca-40 and Ti isotopes, 18: 24672
SATCHLER, G. R., Scattering from polarized nuclei, 18: 24645
SATRE, J. P., Data processing in the control of nuclear reactors, 18: 24828
SAUTRAY, Roger Robert, Solvent purification in plants treating irradiated fuels, 18: 23698 (CEA-R-2404)
SAVAGE, D. J., Liquid radioactive waste disposal at hospital, 18: 24985
SAVAGE, Nancy, Segregation of structural elements during cell division, 18: 23163 (ANL-6823(p.178-88))
SAVCHENKO, O. V., Isotropic discharge chamber for detecting tracks of relativistic charged particles, 18: 23874 (JINR-P-1619)
SAVCHENKO, O. Ya., Criterion of similitude for charged-particle motion in electric fields, 18: 24509
SAVITSKII, I. V., Incorporation of radiomethionine in protein fractions of blood serum under effect of irradiation, 18: 23247 (JPRS-24164(p.1-8))
SAVOSKINA, G. P., Complexing of Am with acidic P organic compounds, 18: 23719
SAWHNEY, B. L., Fixation of microquantities of Cs by clay minerals, 18: 23548
SAWICKA, Angela, Influence of x rays on higher plants, 18: 23253 (OTS-61-11326)
SAXBY, W. H., Automatic processing and evaluation of film badge dosimeter, 18: 23818 (AWRE-O-93/63)
SAYDAKOVSKII, Yu. Ya., Effect of aminazine, promedol and dimedrol on barbamyl-induced sleep in animals under radiation sickness, 18: 23363 (JPRS-24817(p.9-14))
SCARBOROUGH, Barron B., Delay of postirradiation test fluids: factor in saccharin avoidance behavior, 18: 23290
SCARSI, L., Analysis of tracks created in Pb-plate spark chamber, 18: 23973
SCHARF, Waldemar, Parameters of ZnS(Ag) scintillators, 18: 23963
SCHELTEN-PETERSSEN, B., Calibration loop for magnetic flowmeter, 18: 23765 (EUR-1631.d)
SCHIAVUTA, E., Polarization of Λ^0 from $\gamma + p = K^+ + \Lambda^0$, 18: 24428
SCHIEFERDECKER, H., Continuous preparation of nuclear track emulsions, 18: 23494
SCHILLING, W., Scattering of subthermal neutrons on lattice defects, 18: 24194 (NP-13930(p.116-17))
SCHMATZ, W., Scattering of subthermal neutrons on lattice defects, 18: 24194 (NP-13930(p.116-17))
SCHMID, E., Nuclear scattering and two-nucleon forces, 18: 24711
SCHMIDT, A., Neutron flash tube—a strong, pulsed neutron source, 18: 24570 (NP-13930(p.141-3))
SCHMIDT, F. H., Light source for production of retinal burns, 18: 23254
SCHMIDT, R., Cerebellum defects in x-irradiated house mice, 18: 23284
SCHMIDT-ROHR, U., Protons from reactions Be^9(d,p)Be^{10}, C^{12}(d,p)C^{13}, O^{16}(d,p)O^{17}, and Ca^{40}(d,p)Ca^{41}, 18: 24648
SCHMITT, R., Gamma-particle discrimination in emulsions by develop 18: 23912
SCHMITT, R., Mechanisms of hypersensitization of ionographic emulsions, 18: 23550
SCHMITT, R., Quantitative energetic comparison between traces, 18: 23910
SCHNEIDER, Alfred, Chemical aspects of PM-1 and PM-3A, 18: 248 (NP-13900(Sect.3))
SCHNEIDER, R. W., Design of blower casings, 18: 23741 (TID-7690 (p.102-5))
SCHNEIDER, Usines, Prog. rpt. on variation of transformation points, 10–12/63, 18: 24152 (EURAEC-1001)
SCHNEIDER, Usines, Prog. rpt. on hydrogen embrittlement tests on steel, 4–6/63, 18: 24153 (EURAEC-1002)
SCHNELL, W., Synchronization between 300-Bev synchrotron and its injector, 18: 24240 (CERN-64-20)
SCHOEBERLE, D. F., ARGUS—program for calculating transient tempe tures, 18: 23763 (ANL-6654)
SCHOPPER, E., Photographic emulsion in relation to other detectors, 18: 23906
SCHREIBER, P. W., Radiation levels within and behind BeO, 18: 240 (XDC-61-1-149)
SCHREK, Robert, Cytotoxic effect of 2 and 5 roentgens on irradiated lymphocytes, 18: 23294
SCHROETER, J., Derivation of Boltzmann's equation. I., 18: 24507
SCHUBERT, Maxwell, Degradation of proteinpolysaccharide from cartilag 18: 23217
SCHUEGRAF, K., High-purity Ge—surface conduction and carrier life, 18: 25030 (ORNL-tr-120)
SCHULCZEWSKI, Ramon H., Effects of temperature on plastic scintill and its compensation, 18: 23964
SCHULTZ, Claude Henry, Scattering of π mesons from polarized proton target, 18: 24404 (UCRL-11149)
SCHULZ, William D., Two-dimensional Lagrangian hydrodynamic differe equations, 18: 23771 (UCRL-6776)
SCHULZE, Paul-Eberhard, Tritium labeling of Artemisia ketones, 18:
SCHULZE, W., Calibration loop for magnetic flowmeter, 18: 23765 (EU 1631.d)
SCHUMAN, R. P., Neutron cross section of Ta-182, 18: 24584 (IDO-16
SCHUSTER, S. H., Structure in energy dependence of $\bar{\nu}$, 18: 24640
SCHWAN, Herbert Alan, Electromotive drive mechanism for control rods, 18: 24841
SCHWANDT, P., Production of beam of polarized H$^-$ ions, 18: 24680
SCHWARZ, H., High-temperature helium compressor, 18: 23745 (TID-7 (p.236-44))
SCHWEPPE, E. J., Consequent procedures in convention computers, 18: 24992 (IS-904)
SCROGGIE, Lucy E., Synthesis and infrared absorption of N,N',N''-trimethylborazine, 18: 23571 (ORNL-TM-860)
SEAHOLM, John E., Effect on catalase of compounds related to aminotriazole, 18: 23187 (ANL-6823(p.91-8))
SEAHOLM, John E., Reduction of erythrocyte catalase level. II., 18: 23186 (ANL-6823(p.86-90))
SEALE, R. L., Coupled-core reactors, 18: 24848 (LAMS-2967)
SEAMAN, G. C., Perturbations in nuclear collective motion, 18: 2473
SEARLE, Leonard, Studies of the peculiar A stars. II., 18: 24274
SEARS, W. C., Radiation-induced changes in polyethylenes, 18: 2420
SEDLACEK, Z., Equations of motion of particle in circular accelerator, 18: 24257
SEDLACEK, Z., Stability of equilibrium orbits in cyclotron. I., 18: 24
SEDLACEK, Z., Stability of equilibrium orbits in cyclotron. II., 18: 24
SEEVERS, Delmar O., Neutron slowing down and absorption logging 18: 23868
SEIKEL, George R., Constant-velocity traveling magnetic wave pla engine, 18: 24754 (NASA-TN-D-2278)
SEILER, F., Tensor polarization of deuterons scattered from He-4, 18: 24647
SEILER, K., High-purity Ge—surface conduction and carrier life, 18: (ORNL-tr-120)
SEIYAMA, Takeyoshi, Excitation spectra of neutron irradiated ZnS: Cu phosphors, 18: 24575

SEKIGAWA, Seishiro, Graft copolymerization of polyethylene with propylene and anhydrous SO_2, 18: 23642 (AEC-tr-6316(p.481-97))
SEKII, Isao, Gamma irradiation of onion bulbs, 18: 23255
SELDIN, E. J., High-temperature tensile creep of graphite, 18: 24147 (WADD-TR-61-72(Vol.XVIII))
SELIVANOVA, N. M., Solubility and thermodynamical properties of $BaSO_4$ and $BaSeO_4$, 18: 23457 (ANL-Trans-23)
SEMENOV, L. F., Application of amino compounds in combination with thiols in practice with acute radiation sickness, 18: 23385
SEMERDZHYAN, S. P., Effects of x rays on horse bean plantules, 18: 23299
SENG, Weng Tung, Extraction properties of Fm and Md, 18: 23725
SENO, Setimaru, Histologic observation on tumor tissue effects by fatty acids from liver of x-ray irradiated rabbits, 18: 23208
SERGEEV, F. N., Absorption of slowed-down π^- mesons in propane, 18: 24475
SERVOZ-GAVIN, Pierre, Enhanced polarization nuclear-free precession magnetometer, 18: 23869
SETTI, R. Levi, Loading of emulsion stacks with aqueous solutions, 18: 23919
SEVERNE, G., General theory of transport processes. II., 18: 24231
SHAFER, J. B., Decay rate prediction for $2\Xi^-$, 18: 24446
SHAHBAZIAN, B. A., Results obtained with emulsions in magnetic field, 18: 23946
SHAKIROVA, S. A., Application of omegatron for investigating structure of gases, 18: 24319
SHAPIRA, A., Lifetime measurement of Σ^0 through its weak interaction, 18: 24442
SHAPIRO, Jay R., Calcium absorption in man, 18: 23226
SHAPIRO, Stanley K., Biosynthesis of methionine in *Saccharomyces cerevisiae*, 18: 23193 (ANL-6823(p.128-40))
SHCHERBAKOV, V. A., Complexing of U(IV) with halide, sulfate, and perchlorate anions, 18: 23534
SHCHERBAKOVA, M. N., Ionization-momentum dependence for electrons, 18: 23953
SHEEN, E. M., Annunciator for a reactor automatic controller, 18: 24887 (HW-80921)
SHEFFIELD, James C., Mass analysis of small samples utilizing sputtering ion source, 18: 23406 (CONF-512-4)
SHEIDINA, L. D., Absorption of radioactive isotopes from aqueous and water-ethanol solutions, 18: 23724
SHEPHARD, W. D., Production of two charged pions in 871-Mev π^--p interactions, 18: 24418
SHEPPARD, J. C., Kinetics of reduction of Np(VI) by V(III) in perchloric acid, 18: 23485
SHERIF, H., Three-nucleon stripping process, 18: 24687
SHERMAN, Charles H., Energy straggling in series of absorbing layers, 18: 24297 (AFCRL-63-558)
SHERMAN, Walter C., Crater nomenclature, 18: 25018 (UCRL-7750)
SHERRY, Edward V., Jr., Separation by liquid-liquid extraction, 18: 23739
SHEVNINA, N. F., Visual observations of auroras, 18: 24529
SHEVCHUCK, Sergey, Impossible to conceal an atomic explosion, 18: 23805 (UCRL-Trans-1037(L))
SHIBANO, Hiroshi, Radiation-induced polymerization of tetrafluoroethylene, 18: 23640 (AEC-tr-6316(p.469-70))
SHIDA, Shoji, ESR absorption of radicals formed in sugars, 18: 23651 (AEC-tr-6316(p.573-86))
SHIDA, Shoji, ESR absorption of irradiated acrylamide and meta-acrylamide, 18: 23652 (AEC-tr-6316(p.587-97))
SHIDA, Shoji, ESR of α,α'-diphenyl-β-picryl hydrazyl, 18: 23399 (AEC-tr-6316(p.551-7))
SHIDA, Shoji, Free radicals from polymers irradiated with UV, 18: 23653 (AEC-tr-6316(p.598-602))
SHIDA, Shoji, Free radical formation in polymers, 18: 23654 (AEC-tr-6316 (AEC-tr-6316(p.609-15))
SHIDA, Shoji, Radiation-induced graft polymerization of cellulose, 18: 23643 (AEC-tr-6316(p.498-500))
SHIDA, Shoji, Radiation-induced oxidation of cyclohexane, 18: 23655 (AEC-tr-6316(p.616-22))
SHIDA, Shoji, Reactions of irradiated acrylamide and meta-acrylamide with gases, 18: 23650 (AEC-tr-6316(p.567-72))
SHIDA, Shoji, Saturation factor of free radicals, 18: 24220 (AEC-tr-6316 (p.603-8))
SHIGEMATSU, Tomomichi, Characteristics of 3-Mev Van de Graaff accelerator, 18: 24250 (AEC-tr-6316(p.413-24))
SHIGEMATSU, Tomomichi, Current measurements on Van de Graaff accelerator, 18: 24251 (AEC-tr-6316(p.425-30))
SHILLING, Arthur William, Improvements in reactor fuel elements, 18: 24837
SHILLING, W. F., Gas-bearing circulators in Dragon, 18: 24917 (TID-7690 (p.207-18))
SHIMANSKII, A. M., Laboratory measuring-registering center, 18: 23861
SHIMOZAWA, Ryosuke, Effects of γ radiation on natural rubber, 18: 23637 (AEC-tr-6316(p.449-55))
SHIMOZAWA, Ryosuke, Properties of natural rubber on irradiation, 18: 23636 (AEC-tr-6316(p.444-8))
SHIMOZAWA, Ryosuke, Radiation-induced polymerization of isoprene, 18: 23638 (AEC-tr-6316(p.456-64))
SHINOHARA, Kenichi, Characteristics of 3-Mev Van de Graaff accelerator, 18: 24250 (AEC-tr-6316(p.413-24))
SHINOHARA, Kenichi, Current measurements on Van de Graaff accelerator, 18: 24251 (AEC-tr-6316(p.425-30))
SHINOHARA, Kenichi, ESR of polycarbonates. I., 18: 23646 (AEC-tr-6316 (p.522-5))
SHINOHARA, Kenichi, ESR of irradiated polyethylene, 18: 23647 (AEC-tr-6316(p.526-33))
SHINOHARA, Kenichi, ESR of irradiated teflon, 18: 23648 (AEC-tr-6316 (p.534-7))
SHINOHARA, M., Elastic scattering of 55-Mev protons by heavy nuclei, 18: 24665
SHINOZAKI, Yoshiharu, Emission characteristics of ZnS phosphors, 18: 23693
SHIOJI, Yuji, Radicals formed by irradiation of polypropylene, 18: 23624 (AEC-tr-6316(p.368-80))
SHIOTA, Tetsunori, Radiation-induced graft polymerization on polyethylene polypropylene, 18: 23589 (AEC-tr-6316(p.105-13))
SHIRANE, G., Magnetic moments and unpaired spin densities in Fe–Rh, 18: 24169
SHISHOV, V. I., Diffusion of cosmic rays, 18: 24330
SHKLOVSKII, I. S., Data on radiogalactics, 18: 24294
SHONO, Yoshihiko, Optical quenching of ESR signals in neutron-irradiated ZnS, 18: 23664
SHPANSKII, V. A., Reactivity of noble gases, 18: 23476
SHTEPA, N. I., Radially focusing properties of static transaxial fields, 18: 24262
SHTRANIKH, I. V., Laboratory measuring-registering center, 18: 23861
SHULL, Franklin B., Prog. rpt. on nuclear physics, 7/1–10/15/64, 18: 24239 (AFOSR-J1340)
SHUL'MAN, A. R., Penetrability of electrons through Al foils, 18: 24317
SHUR, L. I., Discrimination capacity of nuclear emulsion using super-proportional intensifying, 18: 23931
SHUR, L. I., Mechanism of sensitization of nuclear emulsions by dyestuffs, 18: 23499
SHUSTROV, V. A., Cathodic sputtering of W by means of K ions, 18: 24776
SHVEDOV, V. P., Separation of alkali metals by electrophoresis. I., 18: 23729
SHVEDOV, V. P., Separation of alkali metals by electrophoresis. II., 18: 23730
SHVEDOV, V. P., Separation of Sr from Ca, 18: 23721
SHWE, Moung Hla, Track measurements with digitized microscope, 18: 23940
SICHIROLLO, A. E., High grain densities in nuclear emulsions, 18: 23937
SICHIROLLO, A. E., Precision obtainable in measurement of small angles, 18: 23949
SIEGERT, H. J., Inelastic scattering cross sections on Na-23 to 4 Mev, 18: 24597 (NP-13930(p.15))
SIEMSSEN, R. H., Reaction (d,n) on Be-9, B-10, B-11, Si-28, and P-31, 18: 24611 (NP-13930(p.132-3))
SIEMSSEN, R. H., Time-of-flight spectrometer for fast neutrons, 18: 23882 (NP-13930(p.144-6))
SIKOLENKO, V. F., Generator of high-power pulses of nanosecond length, 18: 23843
SILIN, V. P., Geometric optics in electrodynamics of inhomogeneous

plasma, 18: 24799
SILVERMAN, L. B., Reducing volume of low-level radioactive waste, 18: 24986
SILVESTRI, R., Particle disintegration study for re-entering NAP systems, 18: 24933 (AFSWC-TDR-63-51)
SIMBORG, Donald W., Isotope separation factors occurring in chromatography of dual-labeled compounds, 18: 23194 (ANL-6823(p.141-51))
SIMENOG, I. V., Theory of excitation of zero sound in nuclear matter, 18: 24693
SIMMONS, J. E., Neutron-proton depolarization parameter, 18: 24393 (LADC-6357)
SIMONENKO, D. L., Genetic effects of radioisotope incorporated in DNA, 18: 23298
SIMPSON, O. D., Fission cross section of Pu-241, 18: 24586 (IDO-16976)
SIMPSON, O. D., Neutron cross section of Ta-132, 18: 24584 (IDO-16956)
SINCLAIR, D., Evidence that the f^0 has isotopic spin zero, 18: 24466
SINCLAIR, Warren K., RBE of high-energy photons and electrons, 18: 23314
SINGH, A. N., Radioactivity in cooling water in swimming pool reactor, 18: 24947 (AEET/AM/38)
SINGH, M., Small-angle scattering of low-energy γ rays from atomic electrons, 18: 24412
SINHA, S. P., 2,2′-dipyridyl complexes of rare earths. I., 18: 23500
SIRONI, G., Analysis of tracks created in Pb-plate spark chamber, 18: 23973
SIROTINSKAYA, A. A., Emulsions for nuclear research, type-M NIKFI, 18: 23917
SISIGINA, T. I., Vertical distribution of Rn in boundary layer of atmosphere, 18: 24213
SIU, C. L., Radiation genetics of Rhesus monkey, *Macaca mulatta*. I., 18: 23317
SIWICKI, R., Measurements of fast neutrons by BF_3 proportional counter, 18: 23900
SKACHKOV, Yu. F., Time correlation of photons emitted in NeII spectral lines of separate Ne atoms, 18: 24700
SKADCHENKO, N. M., Effect of lime, phosphates, and stable Sr on accumulation of Sr-90 in plants, 18: 23206 (JPRS-24290(p.43-7))
SKORKA, S., Time-of-flight spectrometer for fast neutrons, 18: 23882 (NP-13930(p.144-6))
SKRYABIN, A. M., Calculation of skeleton activity by Sr-90 content of bones, 18: 23224
SLAPA, Mieczyslaw, Silicon surface-barrier detector, 18: 23962
SLATER, W. E., K-N interaction in the I = 0 state at low energies, 18: 24457
SLESAREVSKII, S. O., Performance possibilities and operating experience with water/water reactor, 18: 24958 (NP-13907)
SLUTSKAYA, V. V., Thin films in super high-frequency engineering, 18: 23750
SLUYTERS, Th., Comparison of proton and deuteron acceleration, 18: 24241 (CERN-64-22)
SMEDLEY, C. E., Application of nuclear techniques to the manufacture of high-reliability printed circuit boards, 18: 23841 (TID-20183)
SMIRNOV, O. K., Improvements for emulsions by incorporation of surface-active material, 18: 23495
SMIT, J. A., Effects of x irradiation on incorporation of amino acids into proteins, 18: 23259
SMITH, A. B., Nuclear Cross Sections Advisory Group Meeting, Savannah River, 1/64, 18: 24625 (WASH-1046)
SMITH, A. M., Graphite oxidation and mass transport test facility, 18: 23447 (ORNL-TM-831)
SMITH, B. G., Goldberger-Treiman formula for $\pi^0 \to 2\gamma$ decay, 18: 24434
SMITH, C. W., Fission-product shipping cask, 18: 23823 (HW-65268)
SMITH, F. A., Vibrational de-excitation of O in heteromolecular collisions, 18: 24315
SMITH, F. J., Numerical evaluation of classical angle of deflection, 18: 24468
SMITH, F. R., Prog. rpt. on nuclear burnup analyses, 9–11/63, 18: 24856 (GEAP-4430)
SMITH, Frances M., Track measurements with digitized microscope, 18: 23940
SMITH, J. J., Nuclear reactor safety circuit development, 18: 24826
SMITH, James C., Conditioned aversion to saccharin using x rays as stimulus, 18: 23237 (FSU-2690-15(Paper 3))
SMITH, James C., Conditioned aversion to saccharin using x rays produced by accelerator, 18: 23238 (FSU-2690-15(Paper 4))
SMITH, James C., Conditioned aversion to saccharin using x rays as unconditioned stimulus, 18: 23239 (FSU-2690-15(Paper 5))
SMITH, James C., Conditioned aversion to saccharin during post exposure period, 18: 23240 (FSU-2690-15(Paper 7))
SMITH, James C., Effects of atropine sulfate and physostigmine on aversion to saccharin with x rays as stimulus, 18: 23236 (FSU-2690-15(Paper 2))
SMITH, R. C., Neutron counter for determining weights of U–F compounds, 18: 23875 (K-1586)
SMITH, Robert J., Neutron-flux and γ-dose measurements at AFRRI reactor, 18: 24957 (NDL-TR-59)
SMOLYANKIN, V. T., Production of π mesons in 650-Mev pp collisions, 18: 24476
SMRZH, P., Diffraction p-p scattering, 18: 24392 (JINR-P-1632)
SNITSAR, V. I., Effects of alloying elements on strengthening of Fe–Ni martensites, 18: 24161
SNYDER, A. Boyd, Remote pipetters for hot-cell enclosures, 18: 2384[illegible] (UCRL-9661)
SNYDER, Donald D., Thermal expansion of isotopically enriched Li, 18: 23450 (TID-20252)
SOBOLEV, N. N., Gas states behind reflected shock waves, 18: 24236
SOBUE, Hiroshi, Copolymerization of tetrafluoroethylene with isobutene induced by radiation, 18: 23685
SOBUE, Hiroshi, Effects of γ radiation on natural rubber, 18: 23637 (AEC-tr-6316(p.449-55))
SOBUE, Hiroshi, Gamma-induced polymerization of 4-vinyl pyridine, 18: 23632 (AEC-tr-6316(p.440))
SOBUE, Hiroshi, Gamma-induced polymerization of 5-ethyl 2-vinyl pyridine, 18: 23633 (AEC-tr-6316(p.441))
SOBUE, Hiroshi, Properties of natural rubber on irradiation, 18: 23636 (AEC-tr-6316(p.444-8))
SOBUE, Hiroshi, Radiation-induced copolymerization of ethylene and tetrafluoroethylene, 18: 23626 (AEC-tr-6316(p.431))
SOBUE, Hiroshi, Radiation-induced polymerization of alkyl cyanides, 18: 23627 (AEC-tr-6316(p.432-4))
SOBUE, Hiroshi, Radiation-induced polymerization of acetylene, 18: 236[illegible] (AEC-tr-6316(p.435))
SOBUE, Hiroshi, Radiation-induced addition reaction of chlorine on acetylene, 18: 23629 (AEC-tr-6316(p.436))
SOBUE, Hiroshi, Radiation-induced polymerization of acrylonitrile mixed with ethylene, 18: 23630 (AEC-tr-6316(p.437-8))
SOBUE, Hiroshi, Radiation-induced polymerization of dimethylformamide, 18: 23631 (AEC-tr-6316(p.439))
SOBUE, Hiroshi, Radiation-induced polymerization of chloral, 18: 23634 (AEC-tr-6316(p.442))
SOBUE, Hiroshi, Radiation-induced polymerization of ethylene, 18: 23635 (AEC-tr-6316(p.443))
SOBUE, Hiroshi, Radiation-induced polymerization of isoprene, 18: 23638 (AEC-tr-6316(p.456-64))
SOBUE, Hiroshi, Radiation-induced polymerization of acrylonitrile, 18: 23639 (AEC-tr-6316(p.465-8))
SOBUE, Hiroshi, Radiation-induced polymerization of tetrafluoroethylene, 18: 23640 (AEC-tr-6316(p.469-70))
SODERWALL, A. L., X-irradiation effects on reproductive function in female hamster, 18: 23344
SOKOL'CHIK, V. A., Structural changes and physical properties of reactor IRT-2000, 18: 24960 (NP-13911)
SOKOLOV, A. P., Production of π mesons in 650-Mev pp collisions, 18: 24476
SOKOLOV, S. N., Control of scanning efficiency and estimation of numbered events, 18: 23944
SOKOLOV, S. N., Virtual excitations of compound particle, 18: 24385 (JINR-P-1593)
SOKOLOVA, E. S., Radiative resonance decays involving Λ hyperons, 18: 24387 (JINR-P-1615)
SOKOLSKAYA, I. L., Application of omegatron for investigating structured gases, 18: 24319
SOLE, M. J., Studies of UC_2 precipitates in UC single crystals, 18: 235[illegible]
SOLMITZ, F. T., Decay rate prediction for $2\Xi^-$, 18: 24446
SOLOMAN, Philip M., Absorption coefficient of quasi-molecular H_2

18: 24280
SOLOMIN, N. L., Effect of staph infections on protein content of blood serum of rabbits exposed to irradiation, 18: 23174
SOLOMIN, N. L., Effect of propamine and bicillin-3 on experimental staphylodermia in irradiated rabbits, 18: 23315
SOLOVEV, E. S., Dissociation of H_2^+ ions in collision with atoms and molecules, 18: 24324
SOLOV'EV, L. D., Asymptotic relations between cross sections with EM interaction, 18: 24382 (JINR-E-1623)
SOLTITSKII, B. P., Resolving power of photographic layers, 18: 23915
SOMAROV, V. I., Isotropic discharge chamber for detecting tracks of relativistic charged particles, 18: 23874 (JINR-P-1619)
SOMERTON, W. H., Changes in physical properties of rocks in the vicinity of underground nuclear explosions, 18: 23786 (UCRL-13105)
SOMMER, N. F., Oxygen-dependent postirradiation restoration of *Rhizopus stolonifer* sporangiospores, 18: 23288
SONA, P. G., Conformal group in Minkowsky space, 18: 24498
SOO, S. L., Extended surface thermionic converters, 18: 24361 (ANL-6802(p.144-51))
SOOD, B. S., Small-angle scattering of low-energy γ rays from atomic electrons, 18: 24412
SOROKO, L. M., Production of π mesons in 650-Mev pp collisions, 18: 24476
SOSNOWSKI, R., SIUP geometrical reconstruction program, 18: 23887 (PAN-474/VI)
SOUCEK, B., Pulse-height analysis accuracy at high rates, 18: 23856
SOWIN'SKI, Mieczyslaw, Silicon surface-barrier detector, 18: 23962
SPAHR, H. R., Re-entry flight demonstration number one, 18: 24941 (SC-RR-64-501)
SPANO, A. H., Prog. rpt. on Spert Project, 7–9/63, 18: 24955 (IDO-16931)
SPATZ, H.-Ch., Kinetic behavior of protons and deuterons in ice crystals, 18: 23466
SPEDDING, F. H., Decomposition pressure of Ho carbides, 18: 23440 (CONF-405-38)
SPEIGHT, M. V., Grain-boundary mobility, 18: 23566
SPERBER, Daniel, States of compound nucleus with high angular momentum, 18: 24733
SPICE, R. D., Grain size test for U fuel, 18: 24132 (HW-81752)
SPITSYN, V. I., Catalytic dehydration of cyclohexanol over $MgSO_4$ containing Pa-231, 18: 23672
SPITSYN, Vikt. I., Effect of radiation of S-35 and Mo-99 on size of specific surface of MoS_2, 18: 23696
SPITSYN, Vikt. I., Extraction of Pa, Zr, and Nb n-benzoylphenylhydroxylamines, 18: 23728
SPITZ, J., Hydrolysis of U carbides, 18: 23461 (ORNL-tr-122)
SPRENGER, K., Properties of radio aurorae in medium latitudes, 18: 24536
SPRINGER, A., Scattering of 65-Mev He ions from O-16, 18: 24623 (UCRL-10727)
SPRINGER, T., Interaction cross sections for slow neutrons, 18: 24606 (NP-13930(p.73-4))
SPRINGER, T., Scattering of subthermal neutrons on lattice defects, 18: 24194 (NP-13930(p.116-17))
SPRUILL, Joseph L., Crater nomenclature, 18: 25018 (UCRL-7750)
SRINIVASAN, S., Electronic equipment at CIR, 18: 24948 (AEET/ROD/6)
SRIVASTAVA, Prem P., Regge trajectories for Coulomb potential, 18: 24430
SROUBEK, Z., PMR in irradiated $Sr(NO_3)_2$ single crystal, 18: 23474
STAAS, F. A., Viscous flow of flux in pure superconductor, 18: 24550
STABILINI, G., Pion-nucleon coupling constant, 18: 24423
STACEY, A. J., Cesium-137 sources for radiotherapy, 18: 23389
STADLER, Janice, Acute irradiation effects on reproductivity of mice, 18: 23325
STADLER, Janice, Effects of irradiation over ten generations on reproductivities of mice, 18: 23329
STAIR, William K., Seal systems for GCR, 18: 23743 (TID-7690(p.121-42))
STAPP, H. P., Masses and lifetimes of unstable particles, 18: 24420
STARIK, I. E., Absorption of radioactive isotopes from aqeuous and water–ethanol solutions, 18: 23724
STARIK, I. E., Solvent extraction of Pa from aqueous solutions, 18: 23720
STARODUBOV, Ya. D., Creep rate of Ni after prior deformation at 4.2°K, 18: 24136 (NP-13909)
STASHKOV, A. M., Neuro-endocrine reaction to mercamine and antiffeine and irradiation, 18: 23377
STASHKOV, A. M., Radioprotective properties of neurotropic pharmacological agents, 18: 23362 (JPRS-24817(p.1-8))
STEARNER, S. Phyllis, Radiation effects on chick embryos, 18: 23229 (ANL-6823(p.5-14))
STEFANI, Stefan, Cytotoxic effect of 2 and 5 roentgens on irradiated human lymphocytes, 18: 23294
STEIGER, Naftali H., Effective charges of products of heavy-ion-induced spallation, 18: 24624 (UCRL-10806)
STEINBERGER, Emil, Effect of sex steroids on endogenous respiration of x-irradiated testis, 18: 23333
STEINFINK, H., Crystal chemistry of some rare earth–group VI compounds, 18: 23506
STEINKE, J., Island-cell tumors in irradiated rats in parabiosis, 18: 23286
STEINMEYER, R. H., Rare earth–Po-210 systems, 18: 24127 (CONF-405-33)
STEINRIEDE, William L., Crater nomenclature, 18: 25018 (UCRL-7750)
STENGER, V. J., K-N interaction in the I = 0 state at low energies, 18: 24457
STEPANOV, A. V., Separation of Sr from Ca, 18: 23721
STEPHENSON, Clark C., Entropies of aqueous Li and fluoride ions, 18: 23515
STERNER, S., Tentative level schemes of Mn-51 and Mn-53, 18: 24660
STERNHELL, S., Long-range H^1–H^1 spin-spin coupling, 18: 24234
STEVENS, R. H., Neutron counter for determining weights of U–F compounds, 18: 23875 (K-1586)
STEVENS, R. H., Vacuum distillation system for concentrating heat-labile solutions, 18: 23445 (K-1594)
STEVENS, Walter, Effects of radiation on biosynthesis and biotransformation of corticosteroids, 18: 23348
STEVENSON, M. L., Decay rate prediction for $2\Xi^-$, 18: 24446
STICHEL, P., Photoproduction of pions and Regge poles, 18: 24380 (DESY-64/3)
STIERLIN, U., Forward production of photons from 9-Bev π-p interactions, 18: 24417
STILLER, B., Comparison between emulsions in region of ionization loss, 18: 23952
STILLER, H., Scattering of slow neutrons on rotating molecules, 18: 24299 (NP-13930(p.56-7))
STIPANITS, P., Enrichment of U on peat, 18: 23806
STOCK, R., Protons from reactions $Be^9(d,p)Be^{10}$, $C^{12}(d,p)C^{13}$, $O^{16}(d,p)O^{17}$, and $Ca^{40}(d,p)Ca^{41}$, 18: 24648
STOCKDALE, J. A., Capture of low-energy electrons in chlorobenzene and bromobenzene, 18: 23686
STOCKEN, L. A., Effects of x irradiation on incorporation of amino acids into proteins, 18: 23259
STODOLSKY, Leo, Model of isobar production, 18: 24456
STOEBNER, P., Modifications in mice renal tubes treated with uranyl nitrate, 18: 23214
STOERI, M., Mixed adsorption of Rn on activated charcoal, 18: 23462 (SC-T-64-616)
STOERI, M., Radon adsorption with activated charcoal, 18: 25031 (SC-T-64-617)
STOHR, Jacques Andre, Improvements in fuel element castings, 18: 24869
STOKES, G. E., Neutron cross section of Ta-182, 18: 24584 (IDO-16956)
STOLL, E., Structure of peritectic Pr–Fe and Nd–Fe compounds, 18: 24184
STOLYAROV, S. N., Radiation field of charged particle in moving medium, 18: 24484 (JPRS-24633(p.275-80))
STORK, D. H., K-N interaction in the I = 0 state at low energies, 18: 24457
STOVER, Edward Roy, Pyrolytic graphite article, 18: 24114
STRATMANN, D., Effects of nuclear tests on vlf propagation, 18: 24540
STREET, K., Jr., Excess-kinetic-energy ions in organic mass spectra. I., 18: 25019 (UCRL-10823)
STRELTSOV, V. N., Investigations of γ-quanta, produced in interactions of π^--mesons with nucleons and nuclei at ≈7 Bev, 18: 24391 (JINR-P-1629)
STRELTSOV, V. N., Properties of π^0 mesons produced in π^--N and π^--C interactions, 18: 24390 (JINR-P-1624)
STRIZHIZHOVSKII, A. D., Effects of high-energy protons on cornea epithelium, 18: 23303
STROEMNAES, Oeistein, Effect of temperature during irradiation on brood pattern of dominant lethals, 18: 23279

STROKOV, Yu. F., Optical model for antinucleon–nucleon collisions, 18: 24481

STROUGH, R. I., Technology for the SNAP-50/SPUR powerplant, 18: 24945

STUART, J. G., Internal fuses for power reactors, 18: 24876 (APEX-142)

SU, Hung-kuei, Reactions of heavy elements with multicharged ions. II., 18: 24689

SU, Hung-kuei, Yield of fission fragments from heavy nucleus fission. I., 18: 24690

SUBBOTIN, V. G., Proton emitters among products of heavy-ion-induced reactions, 18: 24737

SUCHOV, L. V., Automatic measurements on fast tracks in photoemulsions, 18: 23942

SUDA, Pavel, Ultra-high-vacuum apparatus, 18: 24225

SUESSMANN, G., Nuclear reactions and optical nuclear model, 18: 24594 (NP-13930(p.1-5))

SUGA, K., Existence of extensive showers of primary γ radiation, 18: 24342

SUGAHARA, T., Reactivation of x-irradiated mouse L cells, 18: 23367

SUGIMOTO, Kenichi, Dose rate effect of chemical dosimetry with chloral hydrate, 18: 23663

SUGIMOTO, Ken'ichi, Radiation-induced isomerization of butene-2, 18: 23666

SUGIMOTO, Ken'ichi, Radiation-induced isomerization of butene-2, 18: 23667

SUGIMOTO, Ken'ichi, Radiation-induced additions of H_2S to olefins, 18: 23668

SUGIMOTO, Shunichi, ESR spectra of irradiated polymers, 18: 23617 (AEC-tr-6316(p.310-13))

SUGIMOTO, Shunichi, Radiation induced oxidation of polymers, 18: 23619 (AEC-tr-6316(p.322-5))

SUGIMOTO, Shunichi, Radiation-induced oxidation of polyethylene, 18: 23620 (AEC-tr-6316(p.326-42))

SUGIMOTO, Shunichi, Radiation-induced oxidation of polyethylene, 18: 23621 (AEC-tr-6316(p.343-5))

SUGIMOTO, Shunichi, Radiation-induced oxidation of polypropylene, 18: 23622 (AEC-tr-6316(p.346-52))

SUGIMOTO, Shunichi, Radiation-induced oxidation of polyvinyl chloride, 18: 23623 (AEC-tr-6316(p.353-8))

SUGIMOTO, Shunichi, Radical production curve of irradiated polymers, 18: 23618 (AEC-tr-6316(p.314-21))

SUGIMOTO, Shunichi, Singlet ESR spectra when polymers are exposed to high radiation flux, 18: 23616 (AEC-tr-6316(p.306-9))

SUGIMURA, Toshiko, Radiation effect on surface phenomena of biological macromolecules, 18: 23690

SUHL, H., Many-body theory of localized d states in metals. II., 18: 24170

SUKHATME, Suhas P., Heat transfer during film condensation of liquid metal vapor, 18: 23768 (MIT-2995-1)

SUNAYASHIKI, Tadashi, Exposure dose by diagnostic x ray in obstetrics, 18: 23831

SUTHERLAND, J. D., Design of the SNAP-10A reactor, 18: 24944

SUZUKI, Hamaji, Strontium-90 in marine organisms, 18: 23212

SVELTO, V., Converter for pulse analysis, 18: 23851

SVERZELLATI, P. P., High grain densities in nuclear emulsions, 18: 23937

SWANEPOEL, P. N., Liquid radioactive waste disposal at hospital, 18: 24985

SWEENEY, Wilbur F., Liquid-liquid settling, 18: 23708 (UCRL-11182)

SWIATAK, H., Algebraic structure of gravitational fields, 18: 24487

SWIATECKI, Wladslaw J., Fission barrier of Tl-201, 18: 24670

SYMONS, C. R., Buckling and reaction rates in Pu–graphite assemblies, 18: 24852

SZABO, P., Antiferromagnetic-ferromagnetic transformation in FeRh, 18: 24166

SZABOLCS, M., Effect of x rays on ATPase activity of myosin, 18: 23258

SZEPFALUSY, P., Pairing correlation in nuclear surface layer, 18: 24630

SZPIKOWSKI, Stanislaw, Shell-model calculations of K-40 energy levels, 18: 24634

SZYMANSKA, Wieslawa, Influence of x rays on higher plants, 18: 23253 (OTS-61-11326)

SZYMANSKI, W., Radiolytic reduction of KIO_3 in alkaline medium, 18: 23674

SZYMCZYK, Boleslaw, Influence of ionizing rays on serum-resistant syphilis, 18: 23391

T

TABATA, Tatsuo, Backscattering of electrons in range 4 to 14 Mev, 18: 24409

TABATA, Tatsuo, Secondary electron monitor for energies below 20 Mev. II., 18: 24253

TABATA, Yoneho, Copolymerization of tetrafluoroethylene with isobutane induced by radiation, 18: 23685

TABATA, Yoneho, Effects of γ radiation on natural rubber, 18: 23637 (AEC-tr-6316(p.449-55))

TABATA, Yoneho, Gamma-induced polymerization of 4-vinyl pyridine, 18: 23632 (AEC-tr-6316(p.440))

TABATA, Yoneho, Gamma-induced polymerization of 5-ethyl 2-vinyl pyridine, 18: 23633 (AEC-tr-6316(p.441))

TABATA, Yoneho, Properties of natural rubber on irradiation, 18: 23636 (AEC-tr-6316(p.444-8))

TABATA, Yoneho, Radiation-induced copolymerization of ethylene and tetrafluoroethylene, 18: 23626 (AEC-tr-6316(p.431))

TABATA, Yoneho, Radiation-induced polymerization of alkyl cyanides, 18: 23627 (AEC-tr-6316(p.432-4))

TABATA, Yoneho, Radiation-induced polymerization of acetylene, 18: 23628 (AEC-tr-6316(p.435))

TABATA, Yoneho, Radiation-induced addition reaction of chlorine on acetylene, 18: 23629 (AEC-tr-6316(p.436))

TABATA, Yoneho, Radiation-induced polymerization of acrylonitrile mixed with ethylene, 18: 23630 (AEC-tr-6316(p.437-8))

TABATA, Yoneho, Radiation-induced polymerization of dimethylformamide, 18: 23631 (AEC-tr-6316(p.439))

TABATA, Yoneho, Radiation-induced polymerization of chloral, 18: 2363 (AEC-tr-6316(p.442))

TABATA, Yoneho, Radiation-induced polymerization of ethylene, 18: 23635 (AEC-tr-6316(p.443))

TABATA, Yoneho, Radiation-induced polymerization of isoprene, 18: 236 (AEC-tr-6316(p.456-64))

TABATA, Yoneho, Radiation-induced polymerization of acrylonitrile, 18: 23639 (AEC-tr-6316(p.465-8))

TABATA, Yoneho, Radiation-induced polymerization of tetrafluoroethylene, 18: 23640 (AEC-tr-6316(p.469-70))

TABUCHI, Akira, Exposure dose by diagnostic x ray in obstetrics, 18: 23831

TAHMISIAN, Theodore N., Trimmer of specimen blocks for ultramicrotomy, 18: 23164 (ANL-6823(p.189-90))

TAILLET, Joseph, Physical mechanism of h-f plasmoid, 18: 24774

TAIT, J. H., Introduction to neutron transport theory, 18: 24581

TAKAHASHI, Osamu, Center-limb effect of solar flare area, 18: 24272 (NP-13804)

TAKAHASHI, Osamu, Measurement of H-alpha flare spectrograms, 18: 2427 (NP-13803)

TAKAHASHI, Osamu, Statistics of solar flares. I., 18: 24270 (NP-13802)

TAKAMORI, Yasuhiko, Radiation-induced leukemia in mice. I., 18: 23256

TAKAYANAGI, Kazuo, Charge transfer cross section in atomic collisions, 18: 24321

TAKAYANAGI, Kazuo, Theory of inelastic molecular collisions, 18: 2432

TAKAYANAGI, Kazuo, Vibrational transition in molecular collision. V., 18: 24320

TAKAYANAGI, Kazuo, Vibrational transition in molecular collision. VI., 18: 24322

TAKAZAWA, Yoshihito, Radioisotope renogram and clinical application, 18: 23393

TAKEDA, Atsuhiko, Radiation-induced leukemia in mice. I., 18: 23256

TAKEDA, Atsuhiko, Radioactive contamination of vegetables with fallout, 18: 23797

TAKEDA, Atsuhiko, Release of saline-soluble DNA and change in spleen after x irradiation, 18: 23257

TAKESAKI, Junichi, Graft polymerization of polyethylene pre-irradiated in air, 18: 23613 (AEC-tr-6316(p.266-73))

TAKEUCHI, Jugoro, Radioisotope renogram and clinical application, 18: 23393

TAKUMI, K., Scattering of subthermal neutrons on lattice defects, 18: 24194 (NP-13930(p.116-17))

TAMAGNINI, C., Ispra-2—description and safety, 18: 24962 (RT/ING(63)-25)

TAMBIEV, A. Kh., Influence of inactivation on protective properties of antibiotics, 18: 23380

TAMM, I. E., Electrodynamic electron interactions in accelerators, 18: 24264

TAMURA, Naoyuki, Doublet-quintet ESR spectra of irradiated tetrafluoroethylene, 18: 23644 (AEC-tr-6316(p.509-15))

TAMURA, Naoyuki, ESR absorption of irradiated alcohols, 18: 23649 (AEC-tr-6316(p.538-50))

TAMURA, Naoyuki, ESR of irradiated tetrafluoroethylene, 18: 23645 (AEC-tr-6316(p.516-21))

TAMURA, T., Scattering of protons by Ho-165 and Gd-156, 18: 24666

TAMURA, Taro, Description of spherical vibrational nuclei, 18: 24646

TAN, C. C., Radiation genetics of Rhesus monkey, *Macaca mulatta*. I., 18: 23317

TANAKA, Akiko, IR absorption spectra of polyvinyl alcohol while being irradiated, 18: 23590 (AEC-tr-6316(p.121-8))

TANAKA, Y., High-energy muon flux at sea level, 18: 24336

TANDON, P. N., Decay of 4-hour activity of Zn-71, 18: 24657

TANDON, S. N., Detection of sub-micro quantities of Th, 18: 23424

TANG, Y. C., Nuclear scattering and two-nucleon forces, 18: 24711

TANK, L. I., Comparative activity of some radioprotectors for *Vicia faba* seedling roots, 18: 23379

TARAN, Yu. V., Polarization of protons in single crystals of LaMg double nitrate, 18: 23444 (JINR-P-1626)

TARASOV, L. K., Stripping reactions in bombardment of Ta with Ne-20 ions, 18: 24717

TARASOV, N. D., Properties of Nb-base alloys, 18: 24158

TARASSENKOV, V. G., Development of nuclear emulsion in electrodialyzer, 18: 23927

TATISCHEFF-KAPLAN, I., Single photoelectron pulse spectra, 18: 23857

TATLOCK, John, Improvements in reactors, 18: 24928

TATORENKO, V. A., Case of Be poisoning, 18: 23228

TAUBE, M., Extraction properties of Fm and Md, 18: 23725

TAYLOR, A. W. B., Boltzmann equation in electron-phonon systems, 18: 24557

TEIXEIRA PINTO, A. A., Autoradiographic study of incorporation of tritiated thymidine in human chromosomes. I., 18: 23201 (LFEN-N1.11)

TELESHOV, A. S., Gas evolution and double bonds during PIB radiolysis, 18: 23669

TELESHOV, E. N., Gas evolution and double bonds during PIB radiolysis, 18: 23669

TEMNYI (TEMNYY), V. V., Geophysical investigations by means of Cosmos 3 and 5, 18: 24328

TEMNYI (TEMNYY), V. V., Some characteristics of geoactive particles, 18: 24327

TEMPEST, W., Vibrational de-excitation of O in heteromolecular collisions, 18: 24315

TEMPLETON, David H., Crystal structure of Mg sulfate hexahydrate, 18: 25020 (UCRL-10832)

TER-AKOPIAN, G. M., Proton emitters among products of heavy-ion-induced reactions, 18: 24737

TERASAKI, Hideo, Beta-induced exchange of O atoms between CO_2 molecules, 18: 23609 (AEC-tr-6316(p.238-44))

TERASAKI, Hideo, Moisture determination of cellulose fiber using O-18, 18: 23397 (AEC-tr-6316(p.274-82))

TERMAN, A. V., Accumulation of I-131 by skin and hairs, 18: 23207 (JPRS-24704(p.6-11))

TER-MARTIROSYAN, K. A., Four- and five-particle production in high-energy encounters, 18: 24478

TER-MARTIROSYAN, K. A., Peculiarities of partial waves near J = I and asymptotics of amplitude of elastic scattering, 18: 24395 (NP-13872)

TERRANI, S., Instability phenomena in operation of L54M reactor of CESNEF, 18: 24971

TERRY, John L., Jr., Effects of chronic and LD_{50} x-ray doses on reproductive potential of sheep, 18: 23342

TEYSSIER, J. L., Excitation and ionization in rare gases, 18: 23972

THOMA, R. E., Complex compounds in the Na fluoride–rare earth trifluoride systems, 18: 23441 (CONF-405-40)

THOMAS, G. E., Total neutron cross section of Mn, 18: 24678

THOMAS, Harold Albert, Electromotive drive mechanism for control rods, 18: 24841

THOMAS, J. K., Ultraviolet spectra of transients produced in radiolysis of aqueous solutions, 18: 23683

THOMAS, L., Current views about the ionosphere, 18: 24517

THOMAS, T. Y., Outline of theory of the universe, 18: 24290

THOMPSON, L. J., Prog. rpt. on earth resistance to projectile impact, 10/14/64–3/1/64, 18: 25001 (SC-DC-64-459)

THOMPSON, Stanley G., Fission barrier of Tl-201, 18: 24670

THOMSON, John F., Effect of x radiation on oxidative phosphorylation in liver mitochondria, 18: 23233 (ANL-6823(p.157-60))

THORNDIKE, E. H., Quasifree proton-deuteron scattering corrections, 18: 24450

THORNESS, B., Nuclear emulsion plate "shuffler", 18: 23847

TICHO, H. K., K-N interaction in the I = 0 state at low energies, 18: 24457

TIDMAN, D. A., Test particle problem for electron plasma, 18: 24753 (N64-13056)

TIEN, H. Ti, Equilibrium selectivity coefficient of ion-exchange system, 18: 23481

TIETZ, T., Inelastic scattering factor for transitions in atoms, 18: 24307

TIFFANY, C. F., Prediction of pressure vessel minimum fatigue life, 18: 24130 (D2-22437)

TIKHINSKII, G. F., Vapor pressure of solid Y, 18: 24177

TIKHOMIROVA, N. S., Evaluation of plastic lining materials, 18: 25022 (ANL-Trans-15)

TINER, N. A., Particle disintegration study for re-entering NAP systems, 18: 24933 (AFSWC-TDR-63-51)

TINKLER, Almead, Improvements in or relating to grabs, 18: 24832

TISLJAR, M., Beam tube experiments with a divided core, 18: 24849 (NP-13930(p.130))

TIUNOV, L. A., Effects of cytochrome C on radioprotective properties of CO_2, 18: 23383

TKACHENKO, V. M., Effects of h-f electric field on glow discharge, 18: 24796

TKHORIK, Yu. A., Measurement of short lifetimes of current carriers in semiconductor devices, 18: 23756

TOBIN, J. C., Effects of neutron irradiation on Zy-2, 18: 24191 (HW-SA-3194)

TODOROV, V., Leukopenia in radiation disease in rabbits, 18: 23373

TOGAMI, H. K., Re-entry flight demonstration number one, 18: 24941 (SC-RR-64-501)

TOLSTOV, K. D., Control of scanning efficiency and estimation of number of events, 18: 23944

TOLSTOV, K. D., Controlled exposure of nuclear emulsions on sputniks, 18: 23957

TOLSTOV, K. D., Results obtained with emulsions in magnetic field, 18: 23946

TOMAN, John, Crater nomenclature, 18: 25018 (UCRL-7750)

TOMASCH, W. J., Surface superconductivity, 18: 24548

TOMASINI, G., Loading of emulsion stacks with aqueous solutions, 18: 23919

TOMKINS, I. B., Preparation of Mo oxidetetrachloride, 18: 23465

TOMS, M. Elaine, Detection of α particles in γ background, 18: 23930

TORATANI, Hirokazu, Gamma and electron irradiation of clays and soils, 18: 23171

TORATANI, Hirokazu, Gamma irradiation of onion bulbs, 18: 23255

TORATANI, Hirokazu, Measuring tritiated H_2O in soils, 18: 23419

TORCHIA, D., Analysis of nucleon transfer data, 18: 24618 (NYO-1807-8)

TORLIN, B. Z., Calculation of weak self-oscillatory conditions in reactors, 18: 24850 (NP-13963)

TOROPOVA, M. A., Separation of As and Ge phenyl derivatives by partition chromatography, 18: 23733

TOTH, K. S., Angular distribution of N-15 particles from $Al^{27}(O^{16},N^{15})Si^{28}$, 18: 24718

TOTH, K. S., Single-nucleon transfer excitation functions, 18: 24716

TOVE, P. A., Fast-slow coincidence matrix system, 18: 23844

TRAKHTENGERTS, V. Yu., Generation of vlf in outer radiation belt, 18: 24519

TRAMMEL, G. T., Aharonov-Bohm paradox, 18: 24503

TRANCHANT, J., Data processing in the control of nuclear reactors, 18: 24828

TRAUT, H., Linear dose dependence of radiation-induced translocation frequency in *D. melanogaster*, 18: 23282

TRESVYATSKII, S. G., Diagram of system Sc_2O_3–MgO, 18: 23529

TRETYAKOVA, M. I., Ionization-momentum dependence for electrons, 18: 23953

TRIGG, George L., Quantum mechanics, 18: 24513

TRNOVEC, T., Separating elements of alkaline earth group on ion exchangers, 18: 23421

TROUBETZKOY, E. S., Minimum-weight proton shields, 18: 24805 (UNC-5049)

TROUP, G. J., Kronig-Kramers relations in nuclear magnetic resonance, 18: 24659

TROUTNER, David E., Independent fission yield of Sb-127, 18: 24677

TROZERA, T. A., Prog. rpt. on effect of neutron irradiation on materials, 10/63–1/64, 18: 24190 (GA-5037)

TSEKHMISTRENKO, Yu. V., Polarization effect in neutron scattering on nuclei, 18: 24694

TSITSISHVILI, G. V., Sorption of Sr ions on Na molecular screen, 18: 23717

TSUI, Feng-chu, Preparation of single crystals of CaF_2, 18: 23460 (JPRS-24593(p.98-101))

TSUI, Wa-chuang, Production of π mesons in 650-Mev pp collisions, 18: 24476

TSUJII, Yukio, Discharge figures in dielectrics by electron irradiation. II., 18: 24203

TSUMORI, Kunihiko, Dose rate effect of chemical dosimetry with chloral hydrate, 18: 23663

TSUMORI, Kunihiko, Short pulsing for linac. II., 18: 24254

TSURUTA, Koji, Radiation-induced oxidation of cyclohexane, 18: 23655 (AEC-tr-6316(p.616-22))

TSYTOVICH, V. N., Cyclotron acceleration of relativistic particles, 18: 24252 (JPRS-24633(p.26-42))

TSYTOVICH, V. N., Electron acceleration in earth's radiation belts, 18: 24332

TUAN, S. F., Resonance poles for pion-baryon systems, 18: 24429

TUCHSCHEERER, T., Anomalous back-scattering of electron irradiation on vegetable oil–plastic systems, 18: 23688

TUECKE, J. E., FORDRAM—program to calculate group average microscopic resonance absorption and fission cross sections, 18: 24589 (KAPL-M-6131)

TUNITSKII, L. N., Gas states behind reflected shock waves, 18: 24236

TUREK, P., Protons from reactions $Be^9(d,p)Be^{10}$, $C^{13}(d,p)C^{14}$, $O^{16}(d,p)O^{17}$, and $Ca^{40}(d,p)Ca^{41}$, 18: 24648

TURNER, D. T., Radiation-induced branching of polyisobutene molecules, 18: 23682

TURNER, Frederick B., Effects of cratering test on lizards, 18: 23181 (UCLA-12-522)

TURNER, P. C. R., Device for displaying distribution of positron-emitting nuclides *in vivo*, 18: 23903

TUROS, A., Window amplifier, 18: 23839 (PAN-479/I)

TUROVLIN, Bernard, Nuclear reactor fuel element, 18: 24871

TUTTLE, L. W., Retention of Sr-90 in rats, 18: 23243 (UR-642)

TYLER, Albert, Radiation effects on sea urchin sperm, 18: 23339

TYLER, Sylvia, Program to simulate two-component chromatogram, 18: 23195 (ANL-6823(p.152-6))

TZALMONA, A., Measurement of Ge^{73}-proton spin-spin coupling in $Ge(CH_3)_4$, 18: 23561

TZOAR, N., Light-off-light scattering in a plasma, 18: 24788

U

UCHIDA, A., Elastic scattering of 55-Mev protons by heavy nuclei, 18: 24665

UDAGAWA, Takeshi, Description of spherical vibrational nuclei, 18: 24646

UEBERALL, H., Decay angular distributions of intermediate bosons produced by pions, 18: 24397 (NP-13954)

UEDA, Hisashi, ESR absorption of radicals formed in sugars, 18: 23651 (AEC-tr-6316(p.573-86))

UEDA, Hisashi, ESR absorption of irradiated acrylamide and meta-acrylamide, 18: 23652 (AEC-tr-6316(p.587-97))

UEDA, Hisashi, ESR of α,α′-diphenyl-β-picryl hydrazyl, 18: 23399 (AEC-tr-6316(p.551-7))

UEDA, Hisashi, Reactions of irradiated acrylamide and meta-acrylamide with gases, 18: 23650 (AEC-tr-6316(p.567-72))

UJIHARA, Akio, Gamma irradiation of onion bulbs, 18: 23255

ULEHLA, I., π-Meson scattering on nucleons. II., 18: 24414

ULEHLA, Ivan, Theory of the μ meson, 18: 24469

UL'YANOV, R. A., Properties of Nb-base alloys, 18: 24158

UMEZAWA, H., Self-consistent method of quantum field theory, 18: 244

UMEZAWA, M., Invariant quantities in semi-simple groups. II., 18: 244

UMEZAWA, Masao, Graft polymerization of polyethylene pre-irradiated in air, 18: 23613 (AEC-tr-6316(p.266-73))

UNGAR, S. G., Proton relaxation times in alkali halide solutions, 18: 23

UNSTEAD, P. B., Magnetic susceptibility of some carbides of U and Th, 18: 24155

UPENDRA, D. B., Canada India reactor operating experience, 18: 2494 (AEET/ROD/7)

URIST, Marshall R., Effect of tetracycline on retention of Ca and Sr in rodents, 18: 23220

URL, Walter, Radiation protection of plant cells. II., 18: 23374

USATKOV, I. F., High-thermal resistance of products manufactured from ZrO_2, 18: 24111

USIK, P. A., Single-meson exchange and asymptotic behavior of nucleon and pion scattering on nucleons, 18: 24477

USPENSKAYA, M. S., Effects of unithiol on excretion of chemical compounds in urine of rats injured by Po-210, 18: 23382

UTSUMI, Kozo, Histologic observation on tumor tissue effects by fatty acids from liver of x-ray irradiated rabbits, 18: 23208

UVAROVA, V. M., Improvements for emulsions by incorporation of surface-active material, 18: 23495

V

VACHER, J., Apparatus for plotting a reactor thermal flux diagram, 18: 24827

VAKAR, A. B., Effect of D_2O on physical properties of wheat gluten, 18: 23477

VALTER, A. K., Ionization energy losses by fast electrons in thin polystyrene layers, 18: 24702

VAL'TER, A. K., 2-Bev linear electron accelerator, 18: 24248 (NP-13

VAN DEN BROEK, J., Spin-lattice relaxation in rare earth ethylsulphates. II., 18: 23528

VAN DEN HENDE, Jan H., Crystal structure of ferroelectric Li hydrazinium sulfate, 18: 24989 (BNL-7034)

VANDERHAEGHE, G., Applications of emulsions to high-energy nuclear physics at CERN, 18: 24261

VAN DER MAREL, L. C., Spin-lattice relaxation in rare earth ethylsulphates. II., 18: 23528

VANDER VELDE, J., Evidence that the f^0 has isotopic spin zero, 18: 24466

VANDERVOORT, Peter O., Formation of H_{II} regions. III., 18: 24275

VANDERVOORT, Peter O., Formation of H_{II} regions. IV., 18: 24276

VANLERENBERGHE, J., Intravenous injections of Guerin epithelioma. VI. 18: 23264

VAN OMMESLAGHE, Bernard J., Fuel cycles in D_2O-moderated natural-U-fueled reactor, 18: 24905 (NP-13905)

VAN ROOKHUYZEN, P., Mass effect corresponding to nuclear deformation in region N ~ 90, 18: 24681

VAN VIJFEIJKEN, A. G., Viscous flow of flux in pure superconductor, 18: 24550

VASIL'EV, G. A., Effects of cytochrome C on radioprotective properties of CO_2, 18: 23383

VAUCHER, B., Angular distribution inelastic diffusion of neutrons in C, 18: 24603 (NP-13930(p.51-3))

VAYSBERG, O. L., Some characteristics of geoactive particles, 18: 2

VDOVENKO, V. M., Complexing of U(IV) with halide, sulfate, and perchlorate anions, 18: 23534

VDOVENKO, V. M., Hydrogen bond in alkyl amine salts. I., 18: 23576

VDOVENKO, V. M., Hydrogen bond in alkyl amine salts. II., 18: 23577

VDOVENKO, V. M., Stoichiometry of compound formed by uranyl nitrate and TOA nitrate, 18: 23544

VEERARAGHAVAN, N., Canada India reactor operating experience, 18: 24949 (AEET/ROD/7)

VEGNI, G., Precision obtainable in measurement of small angles, 18: 2

VEGNI, G., Use of magnetic fields in nuclear emulsions: guard rings, 18: 23938

VEIL, E. I., Prog. rpt. on UO_2 fuel systems, 4/64, 18: 24854 (CEND-

211)
VEINER, M., Thorium acetates, 18: 23543
VELECKIS, Ewald, Decomposition pressure of TcZn$_4$, 18: 23488
VENIKOV, N. I., Search for light neutron nuclei, 18: 24616 (NP-13964)
VENKATESAN, K., Prog. rpt. on [elementary particles], 2/64, 18: 24396 (NP-13947)
VENKATESAN, K., Prog. rpt. on [elementary particles], 3/64, 18: 24399 (NP-13966)
VENTER, R. H., Polarization of spin-$\frac{1}{2}$ particles. I., 18: 24636
VENTERS, Lydie, Strengthening of neutron-irradiated Cu single crystals, 18: 24200 (ANL-Trans-19)
Venuti, G. Campos
see Campos Venuti, G.
VENUTI, G. Campos, Use of internal beam of synchrotron for study of reaction (e,e'p), 18: 24243 (ISS-63/42)
VEPRIK, Ye. M., Controlled exposure of nuclear emulsions on sputniks, 18: 23957
VERDEYEN, J. T., Investigation of dense plasmas by laser radiation, 18: 24745 (ANL-6802(p.120-5))
VERDEYEN, J. T., Plasma diagnostics using EM waves, 18: 24744 (ANL-6802(p.113-19))
VERDIEV, I. A., Four- and five-particle production in high-energy encounters, 18: 24478
VERDINI, Livio, Influence of γ and β irradiations on dislocations in Cu, 18: 24209
VERDIZADE, A. A., Determination of Zr by microperiodate method, 18: 23420
VEREBRYUSOV, V. S., Absorption of slowed-down π^- mesons in propane, 18: 24475
VERHAEGEN, G., Vaporization of alloys at high temperatures, 18: 23455 (WADD-TR-60-782(Pt.XXII))
VERMEULEN, Theodore, Longitudinal dispersion in process equipment, 18: 23755 (UCRL-11157)
VERSHININ, E. F., Ultra-low-frequency auroral radiation, 18: 24521
VERWEIJ, H., Fast tunnel diode monostable circuits, 18: 23863
VIDAL, M., Four-channel digital commutator, 18: 23855
VIDAVSKII, L. M., Conditions for formation of modifications of UO$_2$, 18: 23475
VIGILOTTI, A. J., WIGLE program for solution of two-group space-time diffusion equations in slab geometry, 18: 24572 (WAPD-TM-416)
Vigo, Francisco Dominguez
see Dominguez Vigo, Francisco
VILLA, F., Polarization of Λ^0 from $\gamma + p = K^+ + \Lambda^0$, 18: 24428
VILLAR, E., Distortion of plates swollen with colophony rosin, 18: 23556
VINDUSKA, M., Beta spectrum of unique first-forbidden transitions, 18: 24638
VIOLET, C. E., Ferromagnetism in dilute solutions of Fe in Au, 18: 24143 (UCRL-7390)
VIRYASOV, N. V., Production of particles in nuclei, 18: 24587 (JINR-P-1584)
VISHNYAKOV, V. A., Injection accelerator of electrons with constant phase velocity, 18: 24244 (NP-13908)
VOGEL, Howard H., Jr., Fractionated irradiation of mice, 18: 23230 (ANL-6823(p.15-19))
VOGLER, Frank Henry, Analysis of electrostatic shield for space vehicles, 18: 24807
VOGLER, M., Action of ion beams on nuclear emulsions, 18: 23916
VOHRA, K. G., Radioactivity in cooling water in swimming pool reactor, 18: 24947 (AEET/AM/38)
VOITOVETSKII, V. K., Neutron-neutron interaction in S-state, 18: 24398 (NP-13961)
VOLGER, J., Viscous flow of flux in pure superconductor, 18: 24550
VOLKOV, A. N., Laboratory measuring-registering center, 18: 23861
VOLKOV, V. V., Reactions of heavy elements with multicharged ions. II., 18: 24689
VOLKOV, V. V., Stripping reactions in bombardment of Ta with Ne-20 ions, 18: 24717
VOLTERRA, V., Paramagnetic resonance of Yb^{3+} in CaWO$_4$, 18: 23525
VON BLANKENHAGEN, P., Measurement of the isomeric splitting ratio of In resonances, 18: 24610 (NP-13930(p.114-15))
VONSOVSKIJ, S. V., Electron theory of transition metals, 18: 24305
VORISEK, Miroslav, Temperature measurements of neutrons in thermal column of VVR-S, 18: 24970
VORONKOV, A. E., Automatic measurements on fast tracks in photoemulsions, 18: 23942
VOYTOVICH, P. A., Case of Be poisoning, 18: 23228
VRIENS, L., Collision theory of ionization of atoms by electrons, 18: 24308
VSEVOLODOV, E. B., Experimental, radiation-induced cataract in frogs, 18: 23268
VUKOVIC, J., Change of properties of nuclear emulsions by aging, 18: 23918

W

WADDINGTON, C. J., Nuclear emulsion plate "shuffler", 18: 23847
WAHL, Arthur C., Independent fission yield of Sb-127, 18: 24677
WAHL, George H., Jr., Racemization of 9,10-dihydro-4,5-dimethylphenanthrene, 18: 23574
WAHL, H. P., Karlsruhe Van de Graaff project for fast neutrons, 18: 24246 (NP-13930(p.137-8))
WAKEFIELD, G. F., Decomposition pressure of Ho carbides, 18: 23440 (CONF-405-38)
WALDEN, G. E., X-ray fluorescence tables for topaz crystal, 18: 24216 (Y-1470-B)
WALDINGER, H., Heat transfer effects in moderate accidents to fast reactors, 18: 24817 (NDA-14-134)
WALECKA, J. D., Form factors for strong M1 transitions in light nuclei, 18: 24675
WALKER, Dennis, Reciprocal relations in rotational MGD flow, 18: 23778
WALL, N. S., Relative size of Ca-44 and Ca-40, 18: 24583 (CONF-502-4)
WALLACE, D. M., Automatic processing and evaluation of film badge dosimeter, 18: 23818 (AWRE-O-93/63)
WALMSLEY, S. H., Far infrared spectra of molecular crystals. I., 18: 23558
WALSH, Stanley, Improvements in reactor fuel elements, 18: 24836
WALTER, A. J., Oxygen/metal ratios for U, Pu and (U,Pu) oxides, 18: 23403 (AERE-R-4608)
WALTHER, H., Utilization of Avogadro RSI reactor, 18: 24972
WALTHOUSEN, L. D., Zero power experiments for SM-1 Core III, 18: 24873 (ACNP-64517(Rev.))
WALTON, G. N., Place of materials testing reactors, 18: 24973
WANG, Franklin F. Y., Magnetic susceptibility of GdPO$_4$, TbPO$_4$, and DyPO$_4$, 18: 23512
WANG, Fu-chieng, Separation of Au from chloride solutions, 18: 23718
WANG, K. H., Inelastic scattering of C-12 and O-16 by Pb-208, 18: 24708
WANG, Shih-wei, Nuclear interactions of cosmic high-energy particles, 18: 24346
WANG, Shun-yung, Utilization of α-methoxy-benzyl-acetic acid as precipitant for Zr, 18: 23415 (JPRS-24552(p.60-1))
WANG, Tu-kung, Protective effect of streptomycin against radiation damage in mammals, 18: 23359 (JPRS-24593(p.120-5))
WANG, Tung-seng, Yield of fission fragments from heavy nucleus fission. I., 18: 24690
WANG, Yung-chang, Radiative resonance decays involving Λ hyperons, 18: 24387 (JINR-P-1615)
WANGERSKY, P. J., Application of time-lag models to natural populations, 18: 25012 (TID-20579)
WARBURTON, A. E. A., Analytic properties of Regge trajectories. I., 18: 24421
WARD, John W., Bibliography on Knudsen effusion method, 18: 23446 (LA-3006)
WARREN, S., Island-cell tumors in irradiated rats in parabiosis, 18: 23286
WARSHAW, S. I., Trivalent rare-earth ions in CaF$_2$. II., 18: 23527
WATANABE, Haruhiko, Radiation-induced polymerization by ring cleavage, 18: 23606 (AEC-tr-6316(p.208-11))
WATANABE, Haruhiko, Structure of polymers formed by radiation-induced ring cleavage, 18: 24148 (AEC-tr-6316(p.212-16))
WATANABE, Kazuko, Strontium-90 in marine organisms, 18: 23212
WATANABE, T., Fission cross section of Pu-241, 18: 24586 (IDO-16976)
WATASE, Y., High-energy muon flux at sea level, 18: 24336
WATERS, T. C., Discussion on prestressed concrete pressure vessels, 18: 24825
WATSON, J., Latina power station, 18: 24923

WATT, William, Making impermeable composite carbon tube, 18: 24117

WATTECAMPS, E., Karlsruhe Van de Graaff project for fast neutrons, 18: 24246 (NP-13930(p.137-8))

WAUCQUEZ, Marc, Fuel cycles in organic moderated reactors, 18: 24904 (NP-13904)

WEAVER, Boyd, Chemical differences between the lanthanides and trivalent actinides, 18: 23699 (CONF-405-37)

WEAVER, K., Evidence that the f^0 has isotopic spin zero, 18: 24466

WEBER, Berthold C., Luminescent phenomena and zirconia research, 18: 23661 (UCRL-Trans-1048(L))

WEBER, G., Passage of polarized neutrons through magnetized Fe, 18: 24568 (NP-13930(p.78-9))

WEBER, M. J., Trivalent rare-earth ions in CaF_2. I., 18: 23526

WEBER, M. J., Trivalent rare-earth ions in CaF_2. II., 18: 23527

WEDVIK, Hans, Effect of temperature during irradiation on brood pattern of dominant lethals, 18: 23279

WEHMEYER, D. B., Advanced test reactor fuel plate pressure deflection tests, 18: 24963 (TID-20621)

WEI, Shao, Protective effect of streptomycin against radiation damage in mammals, 18: 23359 (JPRS-24593(p.120-5))

WEIDENBAUM, B., Prog. rpt. on high-performance UO_2 programs, 1–3/64, 18: 24855 (GEAP-3771-12)

WEIK, H., Structure of peritectic Pr–Fe and Nd–Fe compounds, 18: 24184

WEINBERG, S., Derivation of gauge invariance and equivalence principle, 18: 24501

WEINGARTSHOFER, A., Cross sections for ion-molecule reaction $H_2^{+*} + H_2 \to H_3^+ + H$, 18: 24312

WEINREICH, Marcel I., Chemisorption in reaction of gases with solids, 18: 25033 (SC-T-64-901)

WEINREICH, Marcel I., Chromatographic procedures in organic chemistry, 18: 25032 (SC-T-64-618)

WEINREICH, Marcel I., Mixed adsorption of Rn on activated charcoal, 18: 23462 (SC-T-64-616)

WEINREICH, Marcel I., Radon adsorption with activated charcoal, 18: 25031 (SC-T-64-617)

WEINREICH, Marcel I., Remote interactions within macromolecular chains, 18: 25034 (SC-T-64-902)

WEISS, E. J., Crystal chemistry of some rare earth–group VI compounds, 18: 23506

WEISS, Edward S., Strontium-90 content of human bones 1961-63, 18: 23833

WEISSKOPF, Victor F., Structure of nuclei, 18: 24684

WEITKAMP, W. G., Tensor polarization of deuterons scattered from He-4, 18: 24647

WELLER, J. F., Radiationless resonance energy transfer from UO_2^{2+} to Nd^{3+}, 18: 24223

WELLER, W. W., Thermodynamic data for NbC, 18: 23435 (BM-RI-6446)

WERNER, H., Gamma-ray studies of B-11, N-14, and F-19 induced transfer reactions, 18: 24721

WEST, B. R., Design optimization of thermoelectric devices, 18: 24376

WEST, David L., Gas chromatograph for determining O_2, N_2, NO, N_2O, SO_2, and H_2S in steam, 18: 23407 (DP-880)

WESTFALL, William M., Plutonium removal. IX., 18: 23190 (ANL-6823 (p.111-13))

WESTLAKE, D. G., Dislocations of alpha U, 18: 24201 (ANL-Trans-22)

WESTRUM, E. F., Jr., Magnetic susceptibility of several rare earth oxides, 18: 23513

WHIFFEN, D. H., Enhanced double quantum signals in nuclear magnetic resonance, 18: 24644

WHIPPMAN, M. L., Bound states and elementary particles in the limit $Z_1 = 0$, 18: 24458

WHITE, I. B., Re-entry flight demonstration number one, 18: 24941 (SC-RR-64-501)

WHITE, J. L., Oxidation of unirradiated and irradiated nuclear graphites, 18: 24202 (GA-tr-5174)

WHITSTON, O. S., Inactivation of aphthous virus by radiation, 18: 23246 (AERE-Trans-1000)

WHITTLESTONE, W. G., Radioactive Sr and I contents of cow's milk, 18: 23829

WHOLMUT, P. G., Decay rate prediction for $2\Xi^-$, 18: 24446

WIGNER, Eugene P., Symmetry and conservation laws, 18: 24508

WILDERMUTH, K., Nuclear scattering and two-nucleon forces, 18: 24711

WILHELM, H. A., Treatment of Cs ore, 18: 24991 (IS-884)

WILIP, Elmar K., Evaluation of plastic lining materials, 18: 25022 (ANL-Trans-15)

WILIP, Elmar K., Oxidation ferments from higher plants. II., 18: 25023 (ANL-Trans-21)

WILIP, Elmar K., Propagation of harmonic perturbations in liquid which fills serially and parallely connected pump aggregate pipes, 18: 25024 (ANL-Trans-24)

WILIP, Elmar K., Solubility and thermodynamical properties of $BaSO_4$ and $BaSeO_4$, 18: 23457 (ANL-Trans-23)

WILKE, C. R., Mechanism of liquid-liquid settling, 18: 23452 (UCRL-10625)

WILKE, Charles R., Liquid-liquid settling, 18: 23708 (UCRL-11182)

WILLARD, H. B., Prog. rpt. on neutron cross section program, 1–6/64, 18: 24620 (ORNL-TM-874)

WILLARD, H. B., Scattering (n,d) and search for dineutron effects, 18: 24444

WILLIAMS, A. K., Americium capability at Rocky Flats, 18: 23706 (RFP-349)

WILLIAMS, B. R. H., Biology of Solway Firth. VIII., 18: 23785 (PG-Report-577)

WILLIAMS, B. R. H., Biology of Solway Firth. XII., 18: 23180 (PG-Report-578)

WILLIAMS, David William, Improvements in reactor fuel elements, 18: 24837

WILLIAMS, Wentworth, Jr., Energy straggling in series of absorbing layers,

WILLIAMS, R. C., Light source for production of retinal burns, 18: 23254 18: 24297 (AFCRL-63-558)

WILLIS, A. H., Electron microscopy of β beryllia, 18: 23563

WILLIS, Kenneth, Damage assessment and data base on shelter needs, 18: 23826 (NP-13942)

WILLIS, W., Charged sigma hyperon leptonic decays, 18: 24402 (TID-1933

WILLMARTH, T. E., Radiolytic reduction of aqueous Ag nitrate solutions, 18: 23687

WILMORE, D., Even-parity levels of mass-18 nuclei, 18: 24685

WILSON, A. G., Kinematical fitting program for analysis of bubble chamber events, 18: 23877 (NIRL/M/38)

WILSON, G. V. H., Kronig-Kramers relations in nuclear magnetic resonance, 18: 24659

WILSON, P. W., Preparation of Mo oxidetetrachloride, 18: 23465

WILSON, S. A., Crystallographic study of solid benzene, 18: 23575

WINKLER, H., Excitation functions for coulomb excitation of 2+ and 4+ rotational levels in Sm-152, 18: 24727

WINSLOW, Alan M., Equipotential zoning of two-dimensional meshes, 18: 25014 (UCRL-7312)

WINTER-GEGAUFF, Ch., Interaction mechanisms of 200-Mev Ne-20 with Ag and Br nuclei, 18: 24732

WINTHER, Aage, Coulomb excitation in deformed nuclei, 18: 24641

WINTHER, Aage, Multiple coulomb excitation in deformed nuclei, 18: 24728

WITTENBERG, L. J., Prog. rpt. on reactor fuels and materials, annual, 1963, 18: 24815 (MLM-1184)

WOJCICKI, S. G., Decay rate prediction for $2\Xi^-$, 18: 24446

WOLFENDALE, A. W., Antimatter in the cosmic radiation, 18: 24335

WOLFENDALE, A. W., Energy spectrum of cosmic-ray pions, 18: 24341

WOLFENDALE, A. W., Momentum spectrum of cosmic-ray protons, 18: 24339

WOLFENDALE, A. W., Primary and sea-level spectra of cosmic rays, 18: 24340

WOLKENBERG, Andrzej, Thermionic and MHD generators, 18: 24375

WOLLAN, E. O., Antiferromagnetism of Pr, 18: 24172

WOLLAN, E. O., Magnetic structures of rare earth Mn oxides, 18: 23533

WOLLAN, E. O., Magnetic structures of rare earth manganites ($RMnO_3$), 18: 24128 (CONF-405-34)

WOLOCH, F., Beam tube experiments with a divided core, 18: 24849 (NP-13930(p.130))

WOOD, Calvin D., Elastic scattering of π^+ by protons, 18: 24453

WOOD, Calvin D., Elastic scattering of π^- by protons, 18: 24454

WOOD, M., Superconducting magnets and L.1000 cryomagnetic system, 18: 24547

WOOLLEN, W. B., General consideration of health physics control, 18: 23810 (AERE-R-4528(p.1-24))

WOOLLEN, W. B., Health physics control of research reactors, 18: 2380

(AERE-R-4528)

WOOTTON, P., Radiation cataract in clinical therapeutic radiology, 18: 23313

WRIGHT, I. J., Application of nuclear techniques to the manufacture of high-reliability printed circuit boards, 18: 23841 (TID-20183)

WRIGHT, L. E., Inelastic scattering of electrons by nuclei. III., 18: 24669

WRIGHT, William P., Neutron reflection and flux versus depth for Al, 18: 24564 (BRL-1238)

WU, S. H., Effect of radiation on spermatozoan metabolism, 18: 23334

WULFF, Claus A., Entropies of aqueous Li and fluoride ions, 18: 23515

Y

YAGODA, Herman, Development of nuclear emulsions in space probes, 18: 23956

YAHES, R. J., Prog. rpt. on emissivity of materials, final, 7/59–12/62, 18: 24138 (PWA-2206(Vol.I))

YAKEL, H. L., Magnetic structures of rare earth Mn oxides, 18: 23523

YAKEL, H. L., Magnetic structures of rare earth manganites (RMnO$_3$), 18: 24128 (CONF-405-34)

YAKOVLEV, R. M., Nuclear emulsions for investigation of scattering of protons on He-4, 18: 23948

YAM, Kei-Ming, Radiation effects on biochemistry of tissues. I., 18: 23202 (NP-13918(p.1-12))

YAMAGISHI, Shigeru, Reactivation analysis of Hg, 18: 23425

YAMAMOTO, A. S., Vapor pressures of Sm and Gd, 18: 23439 (CONF-405-36)

YAMAMOTO, Michio, Histologic observation on tumor tissue effects by fatty acids from liver of x-ray irradiated rabbits, 18: 23208

YAMAOKA, Hishi, Radiation-induced polymerization of formaldehyde, 18: 23598 (AEC-tr-6316(p.163-7))

YANG, Li-ming, New treatment of pairing force in nuclei. I., 18: 24692

YAREMENKO, Z. A., Diagram of system Sc$_2$O$_3$–MgO, 18: 23529

YARIO, W. R., Metallic wire fuels, 18: 24189 (APEX-730)

YAROSHEVICH, O. I., Structural changes and physical properties of reactor IRT-2000, 18: 24960 (NP-13911)

YEATTS, L. B., Jr., Kinetics of thermal decomposition of biphenyl, 18: 23570 (ORNL-3602)

YEVLASHIN, L. S., Auroral H emission, 18: 24522

YNTEMA, J. L., Reaction (d,He^6) on Ca-40 and Ti isotopes, 18: 24672

YOKORO, Kenjiro, Tumor induction with At-211 in rats, 18: 23261

YOON, Hyo Sub, Non-stoichiometry in CeO$_{2-x}$, 18: 23516

YOSHIDA, Toshio, Excitation spectra of neutron irradiated ZnS: Cu phosphors, 18: 24575

YOSHIDA, Toshio, Optical quenching of ESR signals in neutron-irradiated ZnS, 18: 23664

YOSHIDA, Toshio, Radiation-induced phase transition in ZnS, 18: 23665

YOSHIKAWA, Kazuko, Observation of fallout, 18: 23793

YOSHIMURA, Takeyuki, Radiation-induced graft polymerization of cellulose, 18: 23643 (AEC-tr-6316(p.498-500))

YOSHINAGA, Harumo, Exposure dose by diagnostic x ray in obstetrics, 18: 23831

YOSHIZAWA, Y., Coulomb excitation of vibrational states in deformed nuclei, 18: 24729

YOUNG, James A., Lattice vibrational spectrum of Be, 18: 24168

YOUNG, T. E., Neutron cross section of Ta-182, 18: 24584 (IDO-16956)

YOUNG, T. L., Treatment of Cs ore, 18: 24991 (IS-884)

YPHANTIS, David A., Biosynthesis of methionine in *Saccharomyces cerevisiae*, 18: 23193 (ANL-6823(p.128-40))

YUAN, Yu-kuei, Nuclear interactions of cosmic high-energy particles, 18: 24346

YUDOVICH, L. A., Blackouts and magnetic activity in Southern Hemisphere, 18: 24525

YUDOVICH, L. A., Magnetic activity at conjugate points, 18: 24531

YURA, H. T., Non-linear interactions of EM fields with matter, 18: 24215 (RM-4093-PR)

YURIN, V. A., Stabilization of spontaneous polarization in γ-irradiated triglycine sulfate crystals, 18: 23671

YVARS, M., Oxidation of unirradiated and irradiated nuclear graphites, 18: 24202 (GA-tr-5174)

Z

ZABORENKO, K. B., Solubility of precipitated uranyl phosphates, 18: 23545

ZAGORSKI, Zbigniew P., Fluorescent light emitted by aqueous solution in γ radiation field, 18: 23580 (PAN-488/XVII)

ZAGULYAEVA, V. A., Lunar tidal oscillations of critical frequency of the E layer, 18: 24533

ZAIDMAN, S. Ye., Calculation of skeleton activity by Sr-90 content of bones, 18: 23224

ZAITSEV, V. M., Composition of Sb(V) phenyl derivatives during β decay of Sb-125, 18: 23694

ZAITSEV, V. M., Synthesis of tri-α-naphthylamine Te derivatives, 18: 23695

ZAJDE, Charles, Study, realization, and tuning-up of multichannel detector, 18: 23895

ZAJICEK, G., Radiobiological effect of ^{3}H-thymidine on DNA turnover, 18: 23215

ZAK, J., Magnetic translation group. I., 18: 24504

ZAK, J., Magnetic translation group. II., 18: 24505

ZAKHAROV, V. I., Properties of fine-grain nuclear emulsions, 18: 23498

ZAKHARYEV, B. N., Virtual excitations of compound particle, 18: 24385 (JINR-P-1593)

ZALEWSKI, K., Exact solution of master equation for a model, 18: 24506

ZALKIN, Allan, Crystal structure of Mg sulfate hexahydrate, 18: 25020 (UCRL-10832)

ZAREBSKA, Z., Influence of x rays on higher plants, 18: 23253 (OTS-61-11326)

ZATSEPIN, G. T., Problems in neutrino physics, 18: 24295

ZAVATTINI, E., Forward production of photons from 9-Bev π-p interactions, 18: 24417

ZAWADOWSKI, A., Field-theoretical method in theory of superconductivity, 18: 24545

ZAZUNOV, L. G., Double bremsstrahlung in case of almost collinear momenta, 18: 24704

ZDANSKY, K., PMR in irradiated Sr(NO$_3$)$_2$ single crystal, 18: 23474

ZELINSKII, V. G., Incorporation of radiomethionine in protein fractions of blood serum under effect of irradiation, 18: 23247 (JPRS-24164(p.1-8))

ZEMLYANUKHIN, V. I., Complexing of Am with acidic P organic compounds, 18: 23719

ZERNOVA, K. I., Evaluation of plastic lining materials, 18: 25022 (ANL-Trans-15)

ZHDANOV, A. P., Discrimination capacity of nuclear emulsion using superproportional intensifying, 18: 23931

ZHDANOV, A. P., Nuclear emulsions for investigation of scattering of protons on He-4, 18: 23948

ZHDANOV, G. B., Automatic measurements on fast tracks in photoemulsions, 18: 23942

ZHDANOV, G. B., Ionization-momentum dependence for electrons, 18: 23953

ZHELUDEV, I. S., Stabilization of spontaneous polarization in γ-irradiated triglycine sulfate crystals, 18: 23671

ZHURAVLEV, A. I., Radiation protection of phenoxazine derivatives, 18: 23378

ZIEHL, Ludwig, Preparation of uranyl nitrate of nuclear purity, 18: 23738

ZIESCHE, P., Graphical presentation of S operators with many-particle problem, 18: 24486

ZIGMOND, E. J., Harmonic drive development, 18: 24908 (PWAC-412)

ZIMA, G. E., Computer code for thermodynamic analysis for W and Re vapor plating, 18: 23451 (UCRL-7667)

ZIMAKOV, I. E., Effect of radiation of S-35 and Mo-99 on size of specific surface of MoS$_2$, 18: 23696

ZIMMER, W. H., Sample changer for γ scintillation well detector, 18: 23873 (HW-80798)

ZIMMERMAN, W. Bruce, Thermal expansion of isotopically enriched Li, 18: 23450 (TID-20252)

ZIZIC, B., Change of properties of nuclear emulsions by aging, 18: 23918

ZMYSLOWSKI, Arkadiusz, Temperature computation in multi-tube reactor fuel element, 18: 24867

ZONA, R., Ispra-2—description and safety, 18: 24962 (RT/ING(63)-25)

ZONDER, A., ESADA fuel fabrication, 18: 23404 (AI-8700(Vol.V))

ZSINDELY, A., Effect of x rays on ATPase activity of myosin, 18: 23258

ZUBENKO, Ye. V., Application of omegatron for investigating structure of gases, 18: 24319
ZUBEREK, R., Binding energy of the O-16 nucleus, 18: 24635
ZUCKER, A., Angular distribution of N-15 particles from $Al^{27}(O^{16},N^{15})Si^{28}$, 18: 24718
ZUROMSKY, G., Prog. rpt. on UO_2 fuel systems, 4/64, 18: 24854 (CEND-2863-211)
ZUROMSKY, G., Prog. rpt. on stress-corrosion cracking of stainless steels, 1–3/64, 18: 24125 (CEND-3256-209)
ZVARA, I., Yield of fission fragments from heavy nucleus fission. I., 18: 24690
ZVARA, Ivo, Fragment yields from fission of heavy nuclei by multicharged ions, 18: 24735
ZVAROVA, T. S., Chromatographic separation of rare earths, 18: 23722
ZVAROVA, T. S., Reactions of heavy elements with multicharged ions. II., 18: 24689
ZVAROVA, T. S., Yield of fission fragments from heavy nucleus fission. I., 18: 24690
ZYKOV, A. I., Injection accelerator of electrons with constant phase velocity, 18: 24244 (NP-13908)
ZYTOVITCH, V. N., Ionization-momentum dependence for electrons, 18: 23953

SUBJECT INDEX

Main entries in this index are generally specific materials, things, and processes. These are followed by modifiers that describe the properties of, and processes applied to, the main entries.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. References to report numbers, where appropriate, are included after the abstract number of the citation. Published literature (journal article or book) is indentifiable by the absence of a report number.

General Indexing Style

The user should bear in mind that the ideas presented in the original literature, rather than key words, have been indexed. The indexers have tried to select what seemed the most probable and logical place to look for typical information. Since it is not possible to anticipate where a user would look for information, numerous cross references are included to assist him in his search.

Experience in using an index of this type will be the best guide in obtaining the desired information, and a consideration of synonymous or closely related terms will prove valuable.

Information must be so indexed as to be of the greatest use to the greatest number of users. This requires that a topic be indexed to headings that most specifically describe it and not ordinarily to the headings that describe its ultimate use, nor to the general class headings that include the specific headings. For example, information on the treatment of thyroid disease with I-131 would be indexed under Thyroid Diseases and under Iodine Isotopes I-131, but not necessarily under Radiotherapy. A study of the effects of x radiation on hair would be indexed under both X Radiation and Hair. However, the information would not be indexed under the experimental animal, e.g., Rats, unless the report discusses the effects on rat hair as compared with the effect on the hair of other animals.

The broad, general class headings are used only for general information or for comprehensive reports or articles.

Subject Heading Styles

Generally, the direct form of subject entry is used rather than inverted headings or, in some cases, subheadings; e.g., Amino Acids rather than Acids, amino; Helium Isotopes He-4 rather than Helium—isotopes He-4 or Helium—He-4 isotopes. Note, however, that in some cases modifying terms are used parenthetically in preference to a more direct type of entry which would result in the scattering of information. Organic compounds, however, are usually entered in the index in the inverted form so that substituted compounds can be listed near the parent compound; e.g., Benzene, Bromo- rather than Bromobenzene. In general, the style of nomenclature used is that of *Chemical Abstracts*, except that some items listed in that publication as subheadings are elevated to form part of the main heading; e.g., Butyric Acid, Methyl Ester rather than Butyric Acid—methyl ester.

Alphabetization

Main headings are arranged according to the widely accepted word-by-word alphabetic system. A parenthetic qualifier following a main heading is disregarded in alphabetizing unless there are two or more headings identical except for the parenthetic qualifier, in which case the qualifier determines the order. Headings involving Greek letters are arranged as if the names of the letters were spelled out, e.g., Mesons (π), Mesons (ξ).

Nomenclature of Inorganic Compounds

Inorganic compounds are indexed in the direct form, listing cations in the order of increasing valence in the case of polycationic salts of varying valence and in alphabetic order for polycationic salts in which all cations have the same valence; e.g., Sodium Aluminum Silicates and Potassium Sodium Sulfates.

Multicomponent Systems

Multicomponent alloys, except well-known trade names are indexed under each element in the alloy.

Example: Aluminum–Chromium Alloys are indexed

ALUMINUM ALLOYS
Al–Cr ...
CHROMIUM ALLOYS
Al–Cr ...

Well-known alloys such as Hastelloy are indexed directly with cross references under the element components. Multicomponent systems of elements are indexed similarly.

Example: Silicon–Tungsten Systems are indexed

SILICON SYSTEMS
Si–W ...
TUNGSTEN SYSTEMS
Si–W ...

Multicomponent systems of compounds are similarly indexed under the compound.

Physical States of Materials

In this subject index specification of the physical state of the material, if other than normal, is included in the modifying phrase.

Modifying Phrases (Subheadings)

Descriptive phrases (modifiers), rather than ordinary subheadings, are used under the main headings to give a better indication of the material covered in an abstract than would be possible with only a word or two whenever it appears that such information would be useful. Such phrases are written so that the idea considered most important is presented first, should a not-too-awkward expression result. However, when using this index, the reader is advised to scan all modifiers under a main heading to determine whether any abstracts in addition to the most obvious should be consulted for the desired information. Many of the modifiers are designed to be read in inverted order or to be read with the main heading inserted at the position of the comma in order to obtain a meaningful phrase; e.g., Uranium—allotropic transformation temperatures of, effect of cooling rate on is read "effect of cooling rate on allotropic transformation temperatures of uranium." In many cases, the prepositions have been omitted from such phrases provided no ambiguity results from the omission.

A

- **ABSTRACTS**
  - on plasma interactions with fields, 18: 24746 (ARL-64-34)
- **ACCELERATORS**
  - beam focusing and directing apparatus for, 18: 24267(P)
  - design and performance of electron injector, with constant phase velocity, 18: 24244 (NP-13908)
  - detector development for pulsed, dE/dx plastic scintillation-type, 18: 23993
  - experimental facilities for, 18: 24261
- **ACETALDEHYDE**
  - radioinduced polymerization on alumina base, gamma, 18: 23594(T,R) (AEC-tr-6316(p.137-44))
  - radioinduced reactions with isobutene, gamma, 18: 23610(T,R) (AEC-tr-6316(p.245-52))
  - radioinduced reactions with ethylene, gamma, 18: 23611(T,R) (AEC-tr-6316(p.253-60))
- **ACETAMIDE, THIO-**
  - protective effects against radiation damage to plant cells, 18: 23374
- **ACETANILIDE**
  - nitrogen-15 NMR in, chemical shifts in, 18: 23530
- **ACETATES**
  - chemisorbed on praseodymium dioxide, nature of, 18: 23514
- **ACETIC ACID**
  - photolysis in mixture with ammonium nitrate, formation of amino acids in uv, 18: 23204(T) (JPRS-24164(p.19-42))
- **ACETIC ACID, [(CARBOXYMETHYLIMINO) BIS(ETHYLENENITRILO)] TETRA-**
  - plutonium-239 removal from mice using calcium salt or pentaethyl ester of, 18: 23369
  - protective effects against plutonium uptake in mice, 18: 23350(R) (ANL-6823(p.105-8))
  - protective effects against plutonium injection in mice, 18: 23351(R) (ANL-6823(p.114-15))
- **ACETIC ACID, CYANO-, ETHYL ESTER**
  - complexes with boron, tin, titanium, and zirconium chlorides and titanium bromides, preparation and spectra of, 18: 23471
- **ACETIC ACID, DICHLORO-, METHYL ESTER**
  - radioinduced addition to 1-octene, 18: 23659(T,R) (AEC-tr-6316 (p.669-71))
- **ACETIC ACID, (ETHYLENEDIAMINE) TETRA- COMPLEXES**
  - with erbium, gadolinium, lanthanum, and neodymium, stereochemistry of, 18: 23518
- **ACETIC ACID, MERCAPTO-, SODIUM SALTS**
  - protective effects against radiation damage to plant cells, 18: 23374
- **ACETIC ACID, TRICHLORO-**
  - additive effects on gamma-induced polymerization of cyclopentadiene, furan, pyrrole, and thiophene, 18: 23597(T,R) (AEC-tr-6316(p.154-62))
  - reactions with thorium nitrates, 18: 23543
- **ACETIC ACID, TRICHLORO-, METHYL ESTER**
  - radioinduced addition to 1-octene, 18: 23659(T,R) (AEC-tr-6316 (p.669-71))
- **ACETIC ACID, VINYL ESTER**
  - radioinduced graft polymerization on polyvinyl alcohol, gamma, 18: 23583(T,R) (AEC-tr-6316(p.76-8))
  - radioinduced polymerization at low temperatures, gamma, 18: 23593(T,R) (AEC-tr-6316(p.134-6))
- **ACETIC ACID, VINYL ESTER POLYMERS**
  - properties of, from gamma-induced polymerization of vinyl acetate, 18: 23593(T,R) (AEC-tr-6316(p.134-6))
- **ACETONE**
  - effects on radioinduced graft polymerization of styrene on polyvinyl alcohol, 18: 23581(T,R) (AEC-tr-6316(p.66-9))
  - effects on yields of hydrogen in hydrolysis of water, mechanism of, 18: 23681
  - radioinduced polymerization of, gamma, 18: 23601(T,R) (AEC-tr-6316 (p.178-81))
  - radiolysis of aqueous solutions of, uv spectra of transients in, 18: 23683
- **ACETONE, THENOYLTRIFLUORO-**
  - with europium, laser action in, 18: 24229
- **ACETONITRILE**
  - radioinduced polymerization, 18: 23596(T,R) (AEC-tr-6316(p.152-3))
  - acetonitrile–$AgNO_3$, electric conductivity and viscosity of, 18: 23 (RPI-1999-3)
- **ACETYLENE**
  - irradiation of, effects of argon, hydrogen, and pressure on benzene formation in, 18: 23676
  - radioinduced polymerization at low temperatures, 18: 23628(T,R) (AEC-tr-6316(p.435))
  - radioinduced reactions with chlorine at low temperatures, 18: 23629(T,R) (AEC-tr-6316(p.436))
- **ACROLEIN**
  - diethyl acetal, radioinduced polymerization of, gamma, 18: 23641(T,R) (AEC-tr-6316(p.471-80))
- **ACROLEIN POLYMERS**
  - reactions with metals, effects of pH and temperature on, 18: 2354
- **ACRYLAMIDE**
  - polymerization by irradiated sugars, 18: 23651(T,R) (AEC-tr-6316 (p.573-86))
  - polymerization induced by irradiation and heat treatment, 18: 23652(T,R) (AEC-tr-6316(p.587-97))
  - radioinduced graft polymerization on polyvinyl alcohol, gamma, 18: 23583(T,R) (AEC-tr-6316(p.76-8))
  - radioinduced reactions with gases, 18: 23650(T,R) (AEC-tr-6316(p.567-72))
  - radiosensitivity effects on erythrocytes, 18: 23381
- **ACRYLAMIDE POLYMERS**
  - radioinduced reactions with gases, 18: 23650(T,R) (AEC-tr-6316 (p.567-72))
- **ACRYLIC ACID**
  - radioinduced graft polymerization on polyvinyl alcohol, gamma, 18: 23583(T,R) (AEC-tr-6316(p.76-8))
  - radioinduced graft polymerization on polyethylene terephthalate, gamma, 18: 23657(T,R) (AEC-tr-6316(p.640-9))
- **ACRYLIC ACID, ETHYL ESTER**
  - radioinduced graft polymerization on polyvinyl alcohol, gamma, 18: 23583(T,R) (AEC-tr-6316(p.76-8))
- **ACRYLIC ACID, METHYL ESTER**
  - radioinduced graft polymerization on polyvinyl alcohol, gamma, 18: 23583(T,R) (AEC-tr-6316(p.76-8))
- **ACRYLIC ACID POLYMERS**
  - radiation effects on surfaces of molecules of, in solution, 18: 2369
- **ACRYLONITRILE POLYMERS**
  - electric properties of heat-treated, 18: 24149(T,R) (AEC-tr-6316 (p.226-31))
- **ACRYLONITRILES**
  - radioinduced graft polymerization on polyvinyl alcohol, gamma, 18: 23583(T,R) (AEC-tr-6316(p.76-8))
  - radioinduced graft polymerization on polyethylene, 18: 23613(T,R) (AEC-tr-6316(p.266-73))
  - radioinduced graft polymerization on cotton and rayon, gamma, 18: 23658(T,R) (AEC-tr-6316(p.650-9))
  - radioinduced polymerization with methyl methacrylate on alumina base, gamma, 18: 23594(T,R) (AEC-tr-6316(p.137-44))
  - radioinduced polymerization in dimethylformamide, additive effects of silver nitrate on gamma, 18: 23595(T,R) (AEC-tr-6316(p.145-51))
  - radioinduced polymerization with diketene, gamma, 18: 23603(T,R) (AEC-tr-6316(p.186-9))
  - radioinduced polymerization with β-propiolactone, 18: 23604(T,R) (AEC-tr-6316(p.190-4))
  - radioinduced polymerization with β-propiolactone, 18: 23605(T,R) (AEC-tr-6316(p.201-7))
  - radioinduced polymerization in ethylene solvent, mechanism of, 18: 23630(T,R) (AEC-tr-6316(p.437-8))
  - radioinduced polymerization of, at low temperatures on urea, 18: 23639(T,R) (AEC-tr-6316(p.465-8))
  - radioinduced polymerization with acrolein diethyl acetal, 18: 2364 (AEC-tr-6316(p.471-80))
- **ACTINIDES**
  - ion-exchange and solvent-extraction properties of, compared with lanthanides, 18: 23699 (CONF-405-37)
  - separation, chromatographic, 18: 23722
- **ACTIVATION ANALYSIS**

development of double, for mercury determination, 18: 23425
efficiency of neutron, second-order effects in, 18: 23428
isotopic interferences and limits in, nomographic determination of, 18: 23422
ACTIVATION DETECTORS
design of fluid-filled, 18: 24840(P)
neutron activation integrals for, computer program for, 18: 23871 (ANL-6822)
use of gold foil as, for absolute thermal neutron flux measurements, 18: 23876 (KFK-180)
use of pellet-type, for neutron flux measurements in reactors, 18: 24829(P)
ADENOSINEPHOSPHORIC ACIDS
formation by spinach chloroplasts, 18: 23198(R) (ANL-6823(p.191-8))
ADRENAL GLANDS
neptunium-237 and plutonium-239 distribution and retention in rat, 18: 23221
radiation effects on protein metabolism in, effects of adrenaline and acetylcholine in guinea pigs on, 18: 23321
radiation effects on cholesterol content of, 18: 23322
ADRENAL HORMONES
effects on enzyme activity in liver of irradiated rats, 18: 23241(R) (NP-13918(p.13-27))
effects on excretion of taurine and sulfate by rats, 18: 25006 (TID-18927)
ADRENALINE
effects on cholesterol content of adrenal glands in rats during radiation sickness, 18: 23322
effects on protein metabolism in adrenal glands of irradiated guinea pigs, 18: 23321
ADVANCED TEST REACTOR
fuel plates for, pressure deflection tests on, 18: 24963 (TID-20621)
AERODYNAMICS
materials evaluation for, data compilation on thermal and mechanical properties of refractory ceramics for, 18: 24141 (RTD-TDR-63-4102)
AGE
radiation effects on beagle reproduction as affected by, x, 18: 23341
AGE ESTIMATION
radiocarbon methods of, for mammoth and woolly rhinoceros fossil remains, 18: 23788
AGING
biological factors affecting, 18: 23165 (BNL-854)
effects on mouse aging and kidney function, 18: 23291
radiation effects on, 18: 23165 (BNL-854)
radioinduced in mice, x, 18: 23291
AGRICULTURE
research progress in Communist China, selected translations on, 18: 25026(T) (JPRS-24593)
AIR
effects on dynamic decomposition of rare earth oxalates, 18: 23507
effects on gamma-induced insect sterility, 18: 23276
effects on radioinduced graft polymerization of styrene on polyvinyl alcohol, 18: 23582(T,R) (AEC-tr-6316(p.70-5))
electron scattering by, electron loss frequencies for, 18: 24300(R) (NP-13953)
fallout monitoring in, at Chacaltaya, Bolivia, 18: 23803
luminescence of alpha-particle tracks in, in electric fields, 18: 23972
properties of, behind shock waves, 18: 24235
separation of iodine vapors from, by adsorption on charcoal, effects of steam on, 18: 23386 (CONF-12-3)
temperatures behind reflected shock waves, 18: 24236
use as carrier gas in radon sorption studies on wood charcoal, 18: 23462(T) (SC-T-64-616)
air–Ar, radiation effects on mass spectra of, electron, 18: 24300(R) (NP-13953)
ALANINE
synthesis and transformation in uv photolysis of organic compounds in mixtures with ammonium compounds, 18: 23204(T) (JPRS-24164 (p.19-42))
β-ALANINE, 2-METHYL-
radiation effects on urinary excretion of, in rats, 18: 23234 (EUR-591.d)
ALANINE, PHENYL-
photolysis of, transformation of amino acids in uv, 18: 23204(T) (JPRS-24164(p.19-42))
synthesis and transformation in uv photolysis of organic compounds in mixtures with ammonium compounds, 18: 23204(T) (JPRS-24164 (p.19-42))
ALASKA
radioactivity content in Eskimos of, 18: 23834
ALBUMINS
radiation effects on dog, x, 18: 23306
ALCOHOLS
synthesis of tertiary, by radioinduced reactions between ethylene and 2-propanol, 18: 23612(T,R) (AEC-tr-6316(p.261-5))
ALGAE
genetic studies in blue-green, 18: 24997 (NYO-3046-1)
radiation effects on chloroplasts in cells of *Chara vulgaris* algae, 18: 23287
strontium-90 content of, from Pacific Ocean in vicinity of Japan, 1959 through 1961, 18: 23792 (WP/37)
ALGINATES
radioinduced free radicals in, gamma, 18: 23651(T,R) (AEC-tr-6316 (p.573-86))
ALKALI METAL HALIDES
proton relaxation times in aqueous solutions of, 18: 23559
ALLOYS
book: *Constitution Diagrams of Metal Systems*, 18: 24180
book: *Constitution Diagrams of Metal Systems*, 18: 24181
ferromagnetism in superconducting, 18: 24561
ALPHA BEAMS
focusing by generator tube, 18: 24237
ALPHA DECAY
gamma angular correlations in, spin relaxation in, 18: 24653
lifetimes, 18: 24467
ALPHA PARTICLES
acceleration in Russian U-120 cyclotron, 18: 24260
biological effects on plant cells, evaluation of various compounds for protection against, 18: 23374
chemical effects on graft polymerization of acrylonitrile and 2-methyl 5-vinyl pyridine on polyethylene, 18: 23613(T,R) (AEC-tr-6316 (p.266-73))
clusters in light nuclei, reduced widths for, 18: 24588 (JINR-P-1595)
collimation in ionization chambers, 18: 24007
detection and discrimination in nuclear emulsion, 18: 23930
detection and discrimination from protons in emulsion, 18: 23931
detection and discrimination of low-energy, emulsions, 18: 23932
detection and discrimination in nuclear emulsions , 18: 23933
detection and measurement in water, apparatus for, 18: 23828(R) (UCRL-7637)
detection and measurement using nuclear emulsion, 18: 23912
detection and measurement of, using nuclear emulsions, 18: 23948
detection and measurement by rare-gas mixtures, 18: 23972
detection and measurement using semiconductor counter telescope, 18: 23985
detection and measurement using 11-micron dE/dx surface barrier semiconductor counters, 18: 23987
detection in nuclear emulsion and measurement, 18: 23924
effects on aqueous sulfuric acid solutions, radiolytic, 18: 23675
effects on DNA metabolism in rats, 18: 23382
emission in carbon reactions (C-12,α) with carbon-12 at 9 to 15.6 Mev, angular distributions for, 18: 24724
emission in lithium reactions with boron-10 and -11 at 3.5 to 4.5 Mev, angular distributions for, 18: 24720
emission in nitrogen reactions (N-14,α) with nuclei at 27 Mev, angular momentum effects in, 18: 24726
monitoring, 18: 23901
reactions (α,p) with nuclei at 18.35 and 30.5 Mev, differential cross sections for, 18: 24687
reactions in nuclear emulsion at 900 Mev, 18: 24619 (NYO-10269)
reactions with americium and plutonium isotopes at 30 to 45 Mev, production of spontaneously fissioning isomer in, 18: 24725
reactions with silver nitrates, decomposition in, 18: 23687
scattering by bromine-81 and magnesium-24, energy levels from, 18: 24620(R) (ORNL-TM-874)

scattering by calcium-40 and -45 at 30.5 Mev, cross sections for elastic, 18: 24583 (CONF-502-4)
scattering by nickel-58 at 43 Mev, interference effects in, 18: 24713
scattering by nuclei at 6 to 19 Mev, analysis of, 18: 24712
scattering by zirconium-90, low-lying states from inelastic, 18: 24661

ALPHA SOURCES
performance of self-focusing, 18: 24237
uses in radiometric megavoltmeter, 18: 23846

ALPHA SPECTROMETERS
collimators for ionization-chamber, 18: 24007

ALUMINUM
alloying effects on iron–nickel alloys, 18: 24161
alloying effects on stress corrosion of mild steel, 18: 24088(T) (AEC-tr-6394)
beta absorption by, energy distribution in, 18: 24219(T,R) (AEC-tr-6316 (p.31-4))
bonding by gas-pressure techniques, 18: 24988(R) (BMI-1665(Del.))
coating with calcium, indium, iron, and lead oxides, electrolytic, 18: 23537
coating with radioactive rare earth for use as radiation source, 18: 24056
coating with rare earth oxides, electrolytic, 18: 23537
compatibility with $(Th_4U)Be_{13}$, 18: 24988(R) (BMI-1665(Del.))
corrosion by water, oxide film tenacity and release of retained film radioactivity in, 18: 24082 (HW-79811)
corrosion protection in aqueous systems at 300 and 330°C by nickel plating, 18: 24083 (HW-81196)
determination in highly radioactive fallout particles, x-ray microscopic, 18: 23794
effects on beryllium crystals, 18: 24066(R) (NMI-2126)
effects on hydrogen embrittlement of steel, 18: 24153(T,R) (EURAEC-1002)
effects on phase transformations in steel, 18: 24152(T,R) (EURAEC-1001)
efficiency drift of foil of, in secondary electron monitor for linear accelerators at 15 Mev, 18: 24253
electron backscattering at 4 to 14 Mev, 18: 24409
electron energy dissipation in, at 1.0, 1.5, and 1.8 Mev, distribution of, 18: 24626(T,R) (AEC-tr-6316(p.35-41))
electron penetration through foils of, energy distribution from 1- to 12-kev, 18: 24317
electron scattering at 1 to 15 kev, angular distributions for, 18: 24304
electron spectra in, low-energy, 18: 24628(T,R) (AEC-tr-6316(p.59-65))
emissivity of coated, in vacuum, 18: 24138(R) (PWA-2206(Vol.I))
emissivity of coated, in vacuum, 18: 24139(R) (PWA-2206(Vol.II))
emissivity of coated, in vacuum, 18: 24140(R) (PWA-2206(Vol.III))
gamma scattering at 280 kev, small-angle, 18: 24412
neutron reactions with, neutron yield in, 18: 24625 (WASH-1046)
neutron reflection and transmission by, Monte Carlo results for, 18: 24564 (BRL-1238)
neutron resonance absorption cross sections for, computer program for calculating, 18: 24589 (KAPL-M-6131)
neutron scattering lengths in, design of interferometer for studying, 18: 23878 (NP-13930(p.76-7))
neutron total cross section of, 18: 24625 (WASH-1046)
polishing by electrolytic methods, 18: 24107(T) (SC-T-64-903)
quenching of, thickness effects on vacancy loop production in, 18: 24144 (UCRL-11188)
radiation effects on crystalline, electron, 18: 24996(R) (NAA-SR-8888(Sect.VI))
reactions with uranium(IV-VI) oxide, analysis of "thermite", 18: 23817(R) (ANL-6880(p.72-8))
separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)
separation from neodymium by ion exchange and solvent extraction, 18: 24856(R) (GEAP-4430)
sorption of americium-241 and protactinium-233 by, from water–ethanol solutions, 18: 23724
sorptive properties for hydrogen and hydroxyl ions, 18: 23448 (PAN-466/V)
stress fatigue in pressure vessels, method of predicting, 18: 24130 (D2-22437)
uses in separation of mercury from radioactive waste solutions by amalgamation, 18: 24977 (ORNL-TM-827)
welding of, Hanford guide to procedures, specifications, and qualification test records for, 18: 24104 (TID-20625(Vol.III))
welding of, to assemble or seal plutonium-containing fuel elements, 18: 24100 (HW-SA-3146)

ALUMINUM ALLOYS
corrosion by water, oxide film tenacity and release of retained film radioactivity in, 18: 24082 (HW-79811)
polishing by electrolytic methods, 18: 24197(T) (SC-T-64-903)
Al–Fe, electric conductivity at high temperatures, 18: 23837 (CEA-R-2402)
Al–Fe–U, phase studies, 18: 24135(R) (NMI-2812)
Al–Fe–U, radiation induced growth in, 18: 24204
Al–Pu, separation of plutonium and transuranium elements from irradiated, by ion exchange, 18: 23702 (ORNL-3566)
Al–Pu–U, performance as zero-power reactor fuel, 18: 24952(R) (ANL-6880(p.6-48))
Al–U, phase studies, 18: 24135(R) (NMI-2812)
Al–U, reactions with steam at 1200 to 1600°C, 18: 23817(R) (ANL-6880(p.72-8))
Al–Zn, radiation effects on pre-precipitation rate in, neutron, 18: 242

ALUMINUM CHLORIDES
catalytic effects on reactions of iodine chloride with trifluoroethylene, 18: 25016 (UCRL-7373)

ALUMINUM COMPOUNDS
preparation of plutonate, with perovskite structure, 18: 23521(P)

ALUMINUM COUPLES
Al/Pb–Tl, surface superconductivity in, 18: 24548

ALUMINUM IODIDES
electric conductivity in iodoethane, iodomethane, and iodopropane solutions, 18: 23449 (PAN-491/V)

ALUMINUM ISOTOPES Al-27
helium reactions (He-3,n) at 25 Mev, spectra of, 18: 24650
meson (π^-) reaction, cross sections of particle production in, 18: 245 (JINR-P-1584)
neutron reactions (n,p) with, for neutron flux measurements, 18: 238 (NP-13930(p.178-80))
neutron reactions (n,α) with, for neutron flux measurements, 18: 238 (NP-13930(p.178-80))
neutron reactions (n,α), sodium-24 yield from, 18: 24592 (NP-13913)
neutron reactions (n,α) at 14 Mev, cross sections for, 18: 24604 (NP-13930(p.54-5))
nitrogen reactions (N-14,O-15) at 27.5 Mev, excitation functions for, 18: 24716
nitrogen reactions $(N\text{-}14,\alpha)$ at 27 Mev, angular momentum effects in, 18: 24726
oxygen reactions (O-16,N-15) at 30 Mev, angular distributions for, 18: 24718
proton reaction (p,d) with, perturbation theory for, 18: 24664

ALUMINUM OXIDES
brazing to niobium in thermionic diodes, 18: 24368 (JPL-TR-32-54
catalytic effects on deuterium, exchange in cyclohexane, 18: 23573
catalytic effects on radioinduced polymerizations of vinyl monomers and aldehydes, 18: 23594(T,R) (AEC-tr-6316(p.137-44))
catalytic effects on radioinduced isomerization of 2-butene, 18: 236
effects on radiation behavior of polymers, 18: 24199(T,R) (AEC-tr-63 (p.359-67))
properties as nuclear thermionic device material, 18: 24367 (GEST-20
sorptive properties for organic compounds, 18: 25032(T) (SC-T-64-61
spectra in low frequency region, infrared, 18: 23549

ALUMINUM SYSTEMS
Al–Si–U, fabrication by casting and splat cooling, 18: 24066(R) (NMI-2126)
Al–Si–U, fabrication and properties of hot-pressed and splat-cooled, 18: 24067(R) (NMI-2127)
Al–Si–U, hardness of splat-cooled, at 600°C, 18: 24066(R) (NMI-212

AMERICIUM
separation from neodymium by ion exchange and solvent extraction, 18: 24856(R) (GEAP-4430)
separation from plutonium processing streams, capabilities at Rocky Flats for, 18: 23706 (RFP-349)
solvent extraction from hydrochloric and perchloric acids by butyl,

dibutyl, and tributyl phosphates, 18: 23719

AMERICIUM ISOTOPES Am-241
- alpha reactions at 30 to 45 Mev, production of spontaneously fissioning isomer in, 18: 24725
- neutron fission cross section of, subthreshold, 18: 24625 (WASH-1046)
- sorption from water–ethanol solutions, 18: 23724

AMERICIUM ISOTOPES Am-242
- production of spontaneously fissioning isomer of, 18: 24725

AMERICIUM ISOTOPES Am-243
- alpha reactions at 30 to 45 Mev, production of spontaneously fissioning isomer in, 18: 24725

AMIDE POLYMERS
- radiation effects on chemical and physical properties of nylon, gamma, thermal, and ultraviolet, 18: 23579 (NP-13825)
- radioinduced free radicals in nylon, concentration of, 18: 23618(T,R) (AEC-tr-6316(p.314-21))
- sorptive properties for organic compounds, 18: 25032(T) (SC-T-64-618)

AMIDES
- effects on sulfur-35-labeled methionine uptake by rat blood serum, 18: 23247(T) (JPRS-24164(p.1-8))
- of imidazoledicarboxylic acids, protective effects of, against radiation injuries in laboratory animals, 18: 23362(T) (JPRS-24817(p.1-8))

AMINES
- protective effects of, against radiation injuries in mice, synergistic effects of thiols, 18: 23385

AMINO ACIDS
- determination in beagle blood of free, 18: 23184(R) (ANL-6823(p.44-75))
- radiation effects on incorporation of, into proteins, x, 18: 23259
- radiation effects on blood serum content of, 18: 23319
- synthesis and transformation in uv photolysis of organic compounds in mixtures with ammonium compounds, 18: 23204(T) (JPRS-24164 (p.19-42))

AMMONIA
- hydrogen isotope exchange with liquid, deuteration enrichment by, 18: 24058(P)
- nitrogen-15 NMR in, chemical shifts in, 18: 23530
- solvent properties for highly radioactive fallout particles, 18: 23795

AMMONIUM CHLORIDES
- nitrogen-15 NMR in, chemical shifts in, 18: 23530

AMMONIUM CHLORIDES, METHYL-
- nitrogen-15 NMR in, chemical shifts in, 18: 23530

AMMONIUM COMPOUNDS
- uses of tungstate, in electrophoretic separation of alkali metals, 18: 23729

AMMONIUM COMPOUNDS, QUATERNARY
- rare earth polarography in, 18: 23463

AMMONIUM IONS
- rotational dynamics of, 18: 24625 (WASH-1046)

AMMONIUM NITRATES
- uses in chromatographic separation of rare earths, 18: 23709(T) (JPRS-24552(p.57-9))

AMOEBA
- cellular components of, isolation and identification of, 18: 23191(R) (ANL-6823(p.118-23))
- electron microscopy of, fixatives for, 18: 23162(R) (ANL-6823(p.174-7))

AMPHIBIANS
- radioinduced gynogenesis in, uv and x, 18: 23335

AMPLIFIERS
- applications of fast circuitry in nuclear physics, 18: 24014
- design and construction of wide-band transistorized, application of sampled parameter method to, 18: 24036
- design and performance for helium-3 and lithium-6 solid-state sandwich detectors in reactors , 18: 24024
- design for fission counters, 18: 24822 (PWAC-427)
- design for silicon junction detectors for low time response, 18: 24023
- design of fully transistorized low-noise, for semiconductor detectors, 18: 23997
- design of window pulse, for pulse-height analyzers, 18: 23839 (PAN-479/I)
- gain stabilization of analog, nanosecond, 18: 24034
- noise suppression in quadrupole, 18: 24516(T) (JPRS-24633)
- time resolution of nanosecond pulse, for semiconductor detector application, 18: 24028

ANALGESICS
- effects on enzyme activity in liver of irradiated rats, 18: 23241(R) (NP-13918(p.13-27))
- radiation effects on duration of sleep induced by, in rats, 18: 23363(T) (JPRS-24817(p.9-14))

ANALYSIS
- methods of, ORNL Master Analytical Manual of, 18: 23410 (TID-7015 (Suppl.6))

ANILINE
- nitrogen-15 NMR in, chemical shifts in, 18: 23530

ANIMAL CELLS
- components of amoeba, isolation and identification of, 18: 23191(R) (ANL-6823(p.118-23))
- nucleic acid metabolism in tumor cells from mice, effects of tritium on, 18: 23215
- radiation effects on survival of HeLa, gamma, 18: 23280
- radiation effects on hamster and rabbit gametic, 18: 23327
- radiation effects on, effects of phosphate buffer on, 18: 23375
- radiation injuries of, mechanisms for, 18: 23316
- radiation injury of, reactivation with cell homogenates or DNA, 18: 23367
- radiosensitivity of rat spermatogonia and primordial germ, 18: 23331
- thymidine metabolism in human, in tissue culture, 18: 23201 (LFEN-N1.11)

ANIMAL REPRODUCTION
- radiation effects on, conference on, 18: 23175
- radiation effects on female Drosophila, x, 18: 23281
- radiation effects on, x, 18: 23324
- radiation effects on mouse, gamma, 18: 23326
- radiation effects on hamster and rabbit, 18: 23327
- radiation effects on mouse and cat, gamma, 18: 23328
- radiation effects on mouse, gamma, 18: 23329
- radiation effects on cattle, after testicular irradiation, x, 18: 23337
- radiation effects on beagle, as affected by aging, x, 18: 23341
- radiation effects on sheep, x, 18: 23342
- radiation effects on rat, gamma, 18: 23343
- radiation effects on hamster, x, 18: 23344
- radiation effects on beagle, x, 18: 23345
- radioinduced gynogenetic, in vertebrates, uv and x, 18: 23335
- radiosensitivity of primordial germ cells and spermatogonia in rat, 18: 23331

ANIMALS
- aging of, effect of somatic mutations on, 18: 23165 (BNL-854)
- chemical composition of marine, 18: 23167(R) (STI/DOC/10/25(p.71-98))
- feeding rates of marine, 18: 23180 (PG-Report-578)
- radioactivity content in aquatic, methods for expression of, 18: 23172
- strontium-90 content of starfish, from Pacific Ocean in vicinity of Japan, 1959 through 1961, 18: 23792 (WP/37)

ANION EXCHANGE MATERIALS
- sorptive properties of Dowex-1X8, for metals from acid-organic solvent media, 18: 23707(R) (TID-20609)

ANP REACTORS
- shielding requirements and specifications, board report on, 18: 24934 (ANP-53)

ANTENNAS
- radiation field of, diffraction of, 18: 24516(T) (JPRS-24633)
- radiation from cylindrical wire, in isotropic plasma, 18: 24516(T) (JPRS-24633)

ANTIBIOTIC THERAPY
- effects on blood serum protein content in irradiated rabbits with infection, 18: 23174
- of infection in irradiated rabbits, 18: 23315

ANTIBODIES
- incorporation of iodine-131 in, effects of lysines on deposition of rat, 18: 23219

ANTIGENS
- protective effects of bacterial, against radiation sickness in rabbits, 18: 23360(T) (JPRS-24704(p.1-5))

ANTIMONY COMPOUNDS
- organic, preparation and chemical changes due to antimony-125 decay in phenyl, 18: 23694

ANTIMONY ISOTOPES Sb-120
gamma spectra of metastable and ground-state, 18: 24585(R) (IDO-16969)
ANTIMONY ISOTOPES Sb-121
energy levels of, lifetime of, 18: 24683
ANTIMONY ISOTOPES Sb-124
diffusion in copper monocrystals, 18: 23522
ANTIMONY ISOTOPES Sb-125
decay of, chemical changes in pentavalent antimony phenyl derivatives during beta, 18: 23694
decay of, preparation of tri-alpha-naphthylamine tellurium by, 18: 23695
determination in soils, radiochemical, 18: 23431
ANTIMONY ISOTOPES Sb-127
production in fission of uranium-235, fractional independent yield for, 18: 24677
ANTIMONY OXIDES
effects on radiation behavior of polymers, 18: 24199(T,R) (AEC-tr-6316 (p.359-67))
spectra in low frequency region, infrared, 18: 23549
ANTINUCLEONS
interactions with nucleons, optical model for, 18: 24481
interactions with nucleons, analysis of total cross sections including channel-crossing for, 18: 24452
interactions with nucleons at high energies, parameters for, 18: 24384 (JINR-P-1577)
interactions with nucleons, meson (π) form factors from, 18: 24471
ANTIPARTICLES
interactions with particles, cross sections for strong and electromagnetic, 18: 24382 (JINR-E-1623)
ANTIPROTONS
content in cosmic particles, 18: 24335
interactions with protons, meson (π) production in, 18: 24474
interactions with protons at 7 to 14 Bev/c, differential cross sections for elastic, 18: 24396(R) (NP-13947)
interactions with protons at high energies, dispersion relations for, 18: 24386 (JINR-P-1598)
ARABINOSE
radioinduced free radicals in, gamma, 18: 23651(T,R) (AEC-tr-6316 (p.573-86))
ARGININE
synthesis and transformation in uv photolysis of organic compounds in mixtures with ammonium compounds, 18: 23204(T) (JPRS-24164 (p.19-42))
ARGON
alpha scattering by, excitation and ionization effects in, 18: 23972
deuterium and deuteron reactions at 20 Mev, electron detachment in, 18: 24310
effects on production of benzene in irradiation of acetylene, 18: 23676
effects on radioinduced isomerization of 2-butene, 18: 23666
electric conductivity of plasma jet of, calculation of, 18: 23532
electric discharge in, microwave resonance emission spectra of, 18: 24772
electric discharge in, stability of, 18: 24784
hydrogen ion reactions at 10 to 180 kev, dissociation in, 18: 24324
properties of, behind shock waves, 18: 24235
temperatures behind reflected shock waves, 18: 24236
thermodynamic properties of plasma of, 18: 24742 (ANL-6802(p.15-18))
ARGON IONS
reactions with nuclear emulsions, effects of energy and mass on grain darkening in, 18: 23916
ARGON ISOTOPES
separation by thermal diffusion, 18: 24050(R) (ORNL-3607)
ARGON ISOTOPES Ar-40
helium reactions (He-3,n) at 25 Mev, spectra of, 18: 24650
proton reactions (p,n) with, 18: 24625 (WASH-1046)
ARGON SYSTEMS
air–Ar, radiation effects on mass spectra of, electron, 18: 24300(R) (NP-13953)
Ar–H, effects on production of benzene in irradiation of acetylene, 18: 23676
Ar–K, production of supersonic plasma of, 18: 24743 (ANL-6802(p.29-36))
Ar–N, nitridation of uranium–zirconium droplets in, 18: 24933 (AFSWC-TDR-63-51)
Ar–O, oxidation of uranium–zirconium droplets in, 18: 24933 (AFSWC-TDR-63-51)
Ar–SF_6, electric conductivity of plasma jet of, 18: 23532
ARGONNE ADVANCED RESEARCH REACTOR
design and physics of, 18: 24953(R) (ANL-6880(p.68-71))
ARGONNE FAST REACTOR EXPERIMENT TEST
development and operations of, summary, 18: 24952(R) (ANL-6880 (p.6-48))
ARMY REACTORS (PM-1)
control rod drive system pressure thimble for, metallurgical examinatio of, 18: 24890 (MND-M-3088 & Add.1)
core development for, 18: 24899 (NP-13900(Sect.4))
operation of, water chemistry control in, 18: 24898 (NP-13900(Sect.3))
packaging for, design of, 18: 24896 (NP-13900(Sect.1))
pressure vessel design, 18: 24897 (NP-13900(Sect.2))
ARMY REACTORS (PM-3)
core development for, 18: 24899 (NP-13900(Sect.4))
operation of, water chemistry control in, 18: 24898 (NP-13900(Sect.3))
ARMY REACTORS (SM-1)
control rod testing for, 18: 24195 (ORNL-TM-815)
Core III for, zero power experiments on, 18: 24873 (ACNP-64517(Rev.1))
ARSENIC COMPOUNDS
organic, separation of phenyl, from germanium phenyl compounds by partition chromatography, tracer studies of, 18: 23733
ARSENIC ISOTOPES As-74
gamma spectra, 18: 24585(R) (IDO-16969)
ARSENIC ISOTOPES As-76
monitoring in reactor coolant water, system for, 18: 24821 (HW-75374)
ARSENIC OXIDES
spectra in low frequency region, infrared, 18: 23549
ASPARTIC ACID
photolysis of, transformation of amino acids in uv, 18: 23204(T) (JPRS-24164(p.19-42))
synthesis and transformation in uv photolysis of organic compounds in mixtures with ammonium compounds, 18: 23204(T) (JPRS-24164 (p.19-42))
ASTATINE ISOTOPES At-211
tumorigenic effects in rats, 18: 23261
ASTROPHYSICS
data on, 18: 24293
data on, 18: 24294
electromagnetic state variations in interplanetary space, effects of solar winds on, 18: 24345
relativistic properties of collapsed objects, 18: 24277
temperature of the solar corona, 18: 24281
ATLANTIC OCEAN
eddy viscosity and currents at various depths off Long Island, 18: 25013 (TID-20612)
ATMOSPHERE
content and distribution in, effect of meteorological conditions on, 18: 24213
cosmic shower development at altitude of 4,200 m, in Bolivia, 18: 243
decontamination by precipitation scavenging, tracer studies using zinc sulfide particles of, 18: 24212 (HW-SA-3167)
fallout monitoring in Osaka Prefecture, 1963, 18: 23793
particle diffusion in, 18: 24333
proton trapping in, spectra of, 18: 24515 (UCRL-11409)
radio absorption in, 18: 24516(T) (JPRS-24633)
ATOMIC EXPLOSIONS
detection and identification of, 18: 23804(T) (UCRL-Trans-1037(L))
effects of high-altitude, on v-l-f radio propagation, 18: 24540
hydrodynamic properties of underground, 18: 23783 (NP-13943(p.209-14))
seismic energy from, studies of high-frequency, 18: 23784 (NP-13956)
uses in excavation projects, depth-of-burst curves for evaluation of, 18: 23752 (UCRL-7793)
uses in mining, evaluation of characteristics for, 18: 23751 (UCRL-7350)
ATOMIC PHYSICS
behavior of charge exchange cross sections in low-energy atomic collisions, 18: 24321
ATOMS

electron reactors with, theory of ionization in, 18: 24308
electron scattering cross sections at low energies, 18: 24302
interactions with ions at low energies, cross sections for charge-exchange, 18: 24321
interactions with atoms in molecules, cross sections for vibrational transitions in, 18: 24322
motion in liquids, 18: 24311
motion on solid surfaces, thermodynamics of, 18: 24069 (NP-13957)
production of highly excited neutral, by charge exchange, 18: 24757 (NP-13948)
production of highly excited neutral, by charge exchange, 18: 24758 (NP-13949)
reactions with radiation fields, dynamics of many-body, 18: 24309
transitions in, inelastic scattering factor for, 18: 24307

AUGER ELECTRONS
spectra at 0 to 20 kev, 18: 24408

AURORAL STORMS
deformations of auroral arc structure, 18: 24538
electron density in, 18: 24532
geographic distribution of arcs and bands 1900 to 1902, shore effects on, 18: 24523
hydrogen spectral emission from, latitude variations of, 18: 24522
model for, 18: 24542
observations on, radar, 18: 24536
radiation from, ulf, 18: 24521
radio noise from electrons in, 18: 24537
solar radiation effects on magnetic disturbances, radiowave absorption, and radar echos from, 18: 24524
survey of, 1957-9, 18: 24529

AUTORADIOGRAPHY
measurement of volume diffusion in single crystals by, 18: 23522
resolvometric techniques in, using sandwiches of thin sheets, 18: 23915
use in study of primary immune reactions in normal and antibody-stimulated mouse spleen, 18: 24998 (ORNL-3595)

AZIDES
combustion and thermal decomposition processes in, mechanism of, 18: 25027(T) (LA-tr-64-2)

B

BACTERIA
radiosensitivity of Micrococcus, extraction of factor for, 18: 23222

BACTERIOPHAGES
radiosensitivity of DNA structural and regulatory mechanisms in, 18: 23269

BALANCES
error analysis of strain-gage, 18: 25002 (SC-TM-64-8)

BARBITURIC ACIDS
5-ethyl-5-phenyl-, synthesis of carbon-14-labeled, 18: 23568 (CEA-R-2406)

BARIUM
separation from strontium by exchange between amalgam and solution, tracer studies of, 18: 23734
sorption by calcium zeolites, selectivity coefficient for, 18: 23480

BARIUM CHLORIDES
protective effects of aqueous solutions of, against radiation in barley seedlings, 18: 23368

BARIUM COMPOUNDS
preparation of plutonate, with perovskite structure, 18: 23521(P)

BARIUM ISOTOPES Ba-140
determination in drinking and river waters and urine by ion exchange, 18: 23421
metabolism, 18: 23816 (AHSB(S) R-64)

BARIUM OXIDES
spectra in low frequency region, infrared, 18: 23549

BARIUM SELENATES
solubility and thermodynamic properties, 18: 23457(T) (ANL-Trans-23)

BARIUM SULFATES
solubility and thermodynamic properties, 18: 23457(T) (ANL-Trans-23)

BARIUM TITANATES
crystal structure of, Berg-Barrett x-ray diffraction studies of, 18: 25035(T) (UCRL-Trans-1055(L))

BARLEY
radiation effects on seedlings of, protective effects of chlorides of barium, beryllium, and strontium against, 18: 23368
strontium-90 content of, from 1963 harvest, 18: 23804

BARYONS
interactions with mesons (π), resonance poles in, 18: 24429
interactions with mesons, use of reciprocal bootstrap in SU(3) symmetry in, 18: 24431
interactions with mesons in U(3) ⊗ U(3) symmetry, resonance, 18: 24465

BEANS
radiation effects on horse, effects of oxygen pressure on, 18: 23299
radiation effects on seedling roots of *Vicia faba*, chemical protection against, 18: 23379

BEARINGS
development of multi-pad gas, 18: 23746 (TID-7690(p.263-72))
friction in, dry, 18: 23742 (TID-7690(p.106-20))
testing hydrostatic gas, 18: 23748 (TID-7690(p.303-12))

BEHAVIOR
radioinduced conditioned aversion to saccharin by rats, 18: 23236 (FSU-2690-15(Paper 2))
radioinduced conditioned aversion to saccharin by rats, 18: 23237 (FSU-2690-15(Paper 3))
radioinduced conditioned aversion to saccharin by rats, 18: 23238 (FSU-2690-15(Paper 4))
radioinduced conditioned aversion to saccharin by rats, 18: 23239 (FSU-2690-15(Paper 5))
radioinduced conditioned aversion to saccharin by rats, 18: 23240 (FSU-2690-15(Paper 7))
radioinduced rat saccharin avoidance, effects of postirradiation fluids on, 18: 23290

BENTONITES
radiation effects on, electron and gamma, 18: 23171
bentonite–diethylaminoethyl cellulose, use as flocculation agent for ruthenium in waste solutions, 18: 24983
bentonite–phosphoryl cellulose, use as flocculation agent for ruthenium in waste solutions, 18: 24983

BENZALDEHYDE
radioinduced polymerization on alumina base, gamma, 18: 23594(T,R) (AEC-tr-6316(p.137-44))

BENZENE
compounds with antimony-125, chemical changes due to beta decay in, 18: 23694
crystal structure of, neutron diffraction studies of, 18: 23575
effects on radioinduced graft polymerization of styrene on polyvinyl alcohol, 18: 23582(T,R) (AEC-tr-6316(p.70-5))
formation in irradiation of acetylene, effects of argon, hydrogen, and pressure on, 18: 23676
neutron scattering spectrum, 18: 24959 (NP-13910)

BENZENE, BROMO-
electron capture by, thermal, 18: 23686
radioinduced dissociation in, cross sections for electron, 18: 23686

BENZENE, CHLORO-
electron capture by, thermal, 18: 23686
radioinduced dissociation in, cross sections for electron, 18: 23686

BENZENE, ETHYNYL-
radioinduced polymerization, 18: 23596(T,R) (AEC-tr-6316(p.152-3))

BENZOIC ACID
photolysis in mixture with ammonium nitrate, formation of amino acids in uv, 18: 23204(T) (JPRS-24164(p.19-42))

BENZONITRILE
benzonitrile–$AgNO_3$, electric conductivity and viscosity of, 18: 25000 (RPI-1999-3)

BERYLLIUM
analysis for chloride, nitrate, perchlorate, and sulfate anions by cation exchange, 18: 23423
corrosion by liquid potassium chloride–sodium chloride at 700, 800, and 900°C, 18: 24089
crystal lattice vibrational spectra, 18: 24168
deformation characteristics under fluid pressure, 18: 24118 (AD-418388)
determination in small solid samples by mass spectroscopy, design of ion source for, 18: 23406 (CONF-512-4)
electron energy dissipation in, at 1.0 to 1.6 Mev, distribution of, 18: 24627(T,R) (AEC-tr-6316(p.42-5))

Fermi surface of crystalline, 18: 24171
mechanical properties of zone-refined single-crystal, 18: 24134(R) (NMI-1257)
neutron diffusion in, 18: 24577
neutron elastic scattering from powdered, 18: 24625 (WASH-1046)
neutron slowing-down spectra in, 18: 24576
neutron spectra in, measurement of time dependence of, 18: 24571(R) (RPI-328-6)
preparation and properties of zone-refined crystalline, effects of aluminum, iron, nickel, and silicon additions on, 18: 24066(R) (NMI-2126)
preparation and properties of zone-refined crystalline, effects of iron and nickel additions on, 18: 24067(R) (NMI-2127)
preparation by organic compound electrolysis, 18: 24078(P)
purification by zone melting, resistivity determination of quality of, 18: 23837 (CEA-R-2402)

BERYLLIUM ALLOYS
Be–Th–U, compatibility of $(Th_4U)Be_{15}$, with aluminum, 18: 24988(R) (BMI-1665(Del.))
Be–Th–U, hardness of $(Th_4U)Be_{15}$, at 25 to 1500°C, 18: 24988(R) (BMI-1665(Del.))
Be–U, fabrication of splat-cooled, 18: 24066(R) (NMI-2126)
Be–U, hardness of cast and splat-cooled, at 600°C, 18: 24066(R) (NMI-2126)
Be–U, hardness of splat-cooled, at 20 to 800°C, 18: 24067(R) (NMI-2127)
Be–Zr, fabrication by splat cooling, 18: 24067(R) (NMI-2127)

BERYLLIUM ALUMINUM SILICATES
beryllium-9 NMR in, Kronig-Kramers relations for, 18: 24659
crystallization in melts of, cooling rate dependence of, 18: 23562

BERYLLIUM CHLORIDES
analysis for chloride anions in, by cation exchange, 18: 23423
protective effects of aqueous solutions of, against radiation in barley seedlings, 18: 23368

BERYLLIUM COMPLEXES
electrolysis of organic, 18: 24078(P)

BERYLLIUM COMPOUNDS
crystal structure, 18: 23502

BERYLLIUM ISOTOPES Be-9
alpha clusters in, reduced widths for, 18: 24588 (JINR-P-1595)
deuteron reactions (d,n) with, angular distributions and cross sections for, 18: 24611 (NP-13930(p.132-3))
deuteron reactions (d,n) with, 18: 24625 (WASH-1046)
deuteron reactions (d,p) at 11.8 Mev, angular distributions for, 18: 24648
emission in boron reactions (B-11,Be-9) with carbon-12 at 115.5 Mev, cross sections for, 18: 24715
energy levels, 18: 24625 (WASH-1046)
helium reactions (He-3,n) at 25 Mev, spectra of, 18: 24650
ion reactions at 6.2 and 9.6 Mev, gamma spectra of, 18: 24721
meson (π^-) reaction, cross sections of particle production in, 18: 24587 (JINR-P-1584)
neutron scattering by, 18: 24625 (WASH-1046)
nuclear magnetic resonance in beryl, Kronig-Kramers relations for, 18: 24659
proton reactions (p,α) with, distributions from, 18: 23948
proton reactions (p,n) at 45 to 95 Mev, spectra from, 18: 24642

BERYLLIUM ISOTOPES Be-10
emission in boron reactions (B-11,Be-10) with carbon-12 at 115.5 Mev, cross sections for, 18: 24715
energy levels, 18: 24625 (WASH-1046)
lithium reactions at 3 Mev, analysis of, 18: 24722

BERYLLIUM MINERALS
crystal structure, 18: 23502

BERYLLIUM NITRATES
analysis for nitrate by ion exchange, 18: 23423

BERYLLIUM OXIDES
crystal structure, 18: 24996(R) (NAA-SR-8888(Sect.VI))
development as coating for reactor fuel particles, 18: 24988(R) (BMI-1665(Del.))
neutron diffusion in, 18: 24577
neutron slowing-down spectra in, 18: 24587
phase transformations in, near 2100°C, 18: 24163
preparation of single-crystal, 18: 24996(R) (NAA-SR-8888(Sect.VI))
production of β, 18: 23563
properties as nuclear thermionic device material, 18: 24367 (GEST-2022)
radiation effects on physical properties of, 18: 24065(R) (GEMP-34A)
shielding properties for gammas and neutrons, data tabulations of, 18: 24806 (XDC-61-1-149)
spectra in low frequency region, infrared, 18: 23549
BeO–CaO, crystallization in melts of, cooling rate dependence of, 18: 23562

BERYLLIUM PERCHLORATES
analysis for perchlorate by cation exchange, 18: 23423

BERYLLIUM POISONING
case history of, 18: 23228

BERYLLIUM STRONTIUM OXIDES
crystallization in melts of, cooling rate dependence of, 18: 23562

BERYLLIUM SULFATES
analysis for sulfate by cation exchange, 18: 23423

BERYLLIUM SYSTEMS
Be–C–U, fabrication by casting, extrusion, and splat cooling, 18: 24066(R) (NMI-2126)
Be–C–U, fabrication and properties of cast, extruded, and splat-cooled, 18: 24067(R) (NMI-2127)
Be–C–U, hardness of cast, extruded, and splat-cooled, at 500 and 600°C, 18: 24066(R) (NMI-2126)

BETA DECAY
book: *The Development of Weak Interaction Theory*, a collection of reprints, 18: 24514
compound production by, in molecular system, 18: 23695
determination of nuclear matrix elements for forbidden transitions from ratio of electron capture to positron emission, 18: 24629
effects of finite nuclear dimensions on unique first-forbidden transitions, 18: 24638
gamma angular correlations in, spin relaxation in, 18: 24653
lifetimes, 18: 24467
spectra at 0 to 20 kev, 18: 24408

BETA PARTICLES
absorption by aluminum, energy distribution in, 18: 24219(T,R) (AEC-tr-6316(p.31-4))
chemical effects on oxygen-18 exchange between carbon dioxide molecules, 18: 23609(T,R) (AEC-tr-6316(p.238-44))
chemical effects on specific surface of molybdenum disulfide, 18: 2366
detection and measurement of, design of halogen-quenched Geiger-Mueller tube for, 18: 24037(P)
dosimetry of, calorimeter for, 18: 23893(T,R) (AEC-tr-6316(p.24-30))
dosimetry using polyvinyl chloride films, 18: 23894(T,R) (AEC-tr-6316(p.46-58))
effects on dislocations in copper, annealing effects on, 18: 24209
monitoring, 18: 23901
use in measuring physical characteristics and conditions, 18: 24048(P)

BETA SPECTRA
analysis by least squares method, 18: 23434
low-energy, in aluminum, 18: 24628(T,R) (AEC-tr-6316(p.59-65))

BETA SPECTROMETERS
design of electrostatic, for low-energy beta spectra, 18: 24628(T,R) (AEC-tr-6316(p.59-65))

BETA SPECTROSCOPY
radiation source preparation for, by electrolytic deposition of rare earths, 18: 24056
use of semiconductor detectors in, 18: 23989
use of semiconductor counters in, 18: 23990

BETATRONS
beam properties in perturbed axially symmetric magnetic field of, 18: 24256

BIBLIOGRAPHIES
on applications and technology of hafnium and zirconium, 18: 24076
on chemistry of zirconium aqueous solutions, 18: 23472
on cosmic radiation, 18: 24347
on dosimetry, 18: 23807 (AED-C-21-01)
on electromagnetic wave interaction with plasma, 18: 24748 (CLM-Bib-4)
on electron theory of transition metals, 18: 24305
on high-energy physics, 18: 24214 (AED-C-23-01)

on high-temperature liquid-metal technology, 18: 24064
on immune reactions, 18: 24998 (ORNL-3595)
on interaction of high-density plasma with fields, 18: 24746 (ARL-64-34)
on ion exchange separation of elements in mixed and non-aqueous media, 18: 23707(R) (TID-20609)
on Knudsen effusion method of vapor pressure measurement, 1940 to 1962, 18: 23446 (LA-3006)
on long-range H^1–H^1 spin-spin coupling in NMR spectroscopy, 18: 24234
on magnetic properties of rare earths, 18: 24178
on mechanics of rarified gases and plasma, 18: 24764 (UTIAS-Rev-18)
on plasma containment, 18: 24748 (CLM-Bib-4)
on properties of high-temperature materials, 18: 24075
on refractory ceramics of interest in aerospace structural applications, 18: 24141 (RTD-TDR-63-4102)
on refractory oxides for nuclear thermionic converters, 18: 24367 (GEST-2022)
on tracer methods for hydrology and soil moisture measurements, 18: 24044 (NP-13931)

BIG ROCK POINT POWER REACTOR
fuel element development and testing, 18: 24885(R) (GEAP-4488)
stability testing, 18: 24885(R) (GEAP-4488)

BIOCHEMISTRY
research on, in Ukrainian SSR, 18: 23169(T) (JPRS-24164)

BIOLOGICAL MATERIALS
analysis for calcium and magnesium, activation, 18: 23418
analysis for uranium, radiochemical, 18: 23405 (CEA-R-2415)

BIOLOGY
research progress in, in Communist China, selected translations on, 18: 25025(T) (JPRS-24552)
research progress in Communist China, selected translations on, 18: 25026(T) (JPRS-24593)

BIOMETRY
model for prediction of population growth, 18: 25012 (TID-20579)

BIOSYNTHESIS
radiation effects on corticosteroid, x, 18: 23348

BIPHENYL
neutron scattering spectrum, 18: 24959 (NP-13910)
thermal decomposition at 422 to 446°C, kinetics of, 18: 23570 (ORNL-3602)

BIPHENYL, CHLORO-
chlorobiphenyl–H_2O, settling mechanism in separation of, 18: 23452 (UCRL-10625)

BIPHENYL, ISOPROPYL-
neutron thermalization in, 18: 24566 (NP-13912)

BIPYRIDINES
complexes with rare earths, preparation and fluorescence and infrared spectra of, 18: 23500

BISMUTH
energy levels in, collective, 18: 24625 (WASH-1046)
neutron scattering lengths in, design of interferometer for studying, 18: 23878 (NP-13930(p.76-7))
photofission at 300 to 1000 Mev, cross sections for, 18: 24655
proton elastic scattering at 55 Mev, effects of nuclear deformation on, 18: 24665
proton reactions with, separation of products from, 18: 23732
reactions of liquid, with tantalum and zirconia, 18: 24815(R) (MLM-1184)

BISMUTH ALLOYS
Bi–Cd, electrochemical properties, 18: 24815(R) (MLM-1184)
Bi–Li, performance in fuel cells, 18: 24355 (ANL-6802(p.53-63))
Bi–Pb, use as shielding-coolant in apparatus for transport of radioactive materials, 18: 23759(P)
Bi–Pt, vaporization at 1350 to 1610°K, 18: 23510

BISMUTH BROMIDES
Bi–BiBr$_3$, electric conductivity of liquid, 18: 24996(R) (NAA-SR-8888(Sect.VI))

BISMUTH IODIDES
Bi–BiI$_3$, thermoelectric potential, 18: 24996(R) (NAA-SR-8888(Sect.VI))

BISMUTH ISOTOPES Bi-209
neutron capture, 18: 24625 (WASH-1046)

BISMUTH OXIDES
spectra in low frequency region, infrared, 18: 23549

BISMUTH SYSTEMS
Bi–BiBr$_3$, electric conductivity of liquid, 18: 24996(R) (NAA-SR-8888(Sect.VI))
Bi–BiI$_3$, thermoelectric potential, 18: 24996(R) (NAA-SR-8888(Sect.VI))

BITUMINOUS MATERIALS
waste solution elution in, 18: 24979(T,R) (EURAEC-202)
waste solution elution in, 18: 24980(T,R) (EURAEC-300)

BLOOD
radiation effects on rat peripheral, effects of serotonin on, 18: 23376

BLOOD FORMATION
radiation effects on, chronic-exposure, 18: 23305

BLOOD PICTURE
during primary immune response in mice, 18: 24998 (ORNL-3595)

BLOOD PLASMA
radiation effects on lipid levels in, 18: 23302
radioinduced lymphoid leukemia effects on lactic dehydrogenase activity in mouse, 18: 23256

BLOOD SERUM
effect of infection on protein content of, in irradiated rabbits, 18: 23174
effects of thiophosphamide on uptake of sulfur-35-labeled methionine by, 18: 23247(T) (JPRS-24164(p.1-8))
radiation effects on amino acid content in, 18: 23319
radiation effects on sulfur-35-labeled methionine uptake by rat, x, 18: 23247 (JPRS-24164(p.1-8))

BLOWERS
casing design for, codes for, 18: 23741 (TID-7690(p.102-5))
design, 18: 24916 (TID-7690(p.189-206))
design of turbo-circulator, for gas cooled reactors, 18: 24913 (TID-7690(p.16-75))
performance, 18: 24917 (TID-7690(p.207-18))
performance of Krupp reactor, 18: 24912 (TID-7690(p.1-15))
rotors for, rotary damping in stability of flexible, 18: 23749 (TID-7690(p.313-30))

BOILERS
design of model sodium-heated steam generator, 18: 23770(R) (TID-20604)
development and operation of once-through single-wall sodium-heated supercritical, 18: 24891(R) (NAA-SR-8888(Sect.I))

BOILING
heat transfer by pool, on stainless steel tubes and flat strips, 18: 23761 (AEEW-R-180)
vapor fractions in nucleate, equations for, 18: 23769 (TID-19075)
void formation in organic coolants during power transients, 18: 24816(R) (NAA-SR-8888(Sect.IV))
void volume measurements in, by gamma attenuation and manometer techniques, 18: 23760(R) (ACNP-64022)

BOILING REACTOR EXPERIMENTS
operations of Borax-V, summary, 18: 24951(R) (ANL-6880(p.1-5))

BOILING REACTORS
design of heavy water-moderated steam-cooled, 18: 24928(P)
design of superheat, 18: 24819(P)
feasibility study of dual-purpose, for Florida Keys, 18: 24906 (NYO-10719)
fuel element burnout in, protection against, 18: 24924
fuel elements for, design of thick-finned, 18: 24862(T,R) (EURAEC-541)
fuel elements for, design of thick-finned, 18: 24863(T,R) (EURAEC-694)
fuel elements for, design of thick-finned, 18: 24864(T,R) (EURAEC-770)
hazards evaluation in STEP project, 18: 24956(R) (IDO-16961)
kinetics of, thermal-hydraulic effects on, 18: 24883(R) (EURAEC-963)
operations of Borax-V, summary, 18: 24951(R) (ANL-6880(p.1-5))

BOLIVIA
cosmic shower development at 4,200 m altitude in, 18: 24343
fallout monitoring at Chacaltaya, 18: 23803

BONDS
formation of hydrogen, in trioctylamine nitrates, 18: 23576
formation of hydrogen, in tridecylamine chloride, 18: 23577

BONE MARROW
effects of injections of homologous, on wound healing in irradiated mice, 18: 23273

protective effects against radiation sickness in mice, 18: 23366
radiation effects on, destruction and restoration phases in, 18: 23265
tibial uptake of plutonium from, 18: 23189(R) (ANL-6823(p.109-10))
BONES
analysis for strontium-90 of, collected from 1961 to 1963, 18: 23833
analysis of, for strontium-90, cesium-137, cerium-144, and radium isotopes, radiochemical, 18: 23402 (AERE-R-4466)
bremsstrahlung efficiency of strontium-90 plus yttrium-90 in dog, 18: 23173
cartilage transformation to, biochemical and physical processes in, 18: 23188(R) (ANL-6823(p.102-4))
plutonium uptake by tibia from bone marrow, 18: 23189(R) (ANL-6823 (p.109-10))
plutonium uptake by mouse, protective effects of diethylenetriaminepentaacetic acid against, 18: 23350(R) (ANL-6823(p.105-8))
plutonium-239 removal from mouse, using calcium salt and pentaethyl ester of carboxymethyliminobis(ethylenenitrilo)tetraacetic acid, 18: 23369
radioinduced sarcomas in mouse, beta and x, 18: 23231(R) (ANL-6823(p.20-43))
strontium-90 content in human, calculation of, 18: 23224
BORAZOLE, *N*-TRIMETHYL-
preparation and infrared spectra, 18: 23571 (ORNL-TM-860)
BORIC ACID
titration of aqueous, using sodium hydroxide, 18: 23412 (UCRL-7756)
BORIDES
book: *High-Temperature Materials*. No. 1, *Materials Index*, 18: 24075
BORON
crystal structure, 18: 24815(R) (MLM-1184)
determination in small solid samples by mass spectroscopy, design of ion source for, 18: 23406 (CONF-512-4)
effects on oxidation resistance of graphite, 18: 24087 (WADD-TR-61-72(Vol.XXX))
heat of sublimation at 298°K, 18: 23479
ion reactions at 6.2 and 9.6 Mev, gamma spectra of, 18: 24721
neutron reactions with, cross sections for thermal, 18: 24578
preparation of self-supporting films of, 18: 24625 (WASH-1046)
BORON CARBIDES
decomposition pressure and heat of dissociation, 18: 23479
fabrication and properties of, as reactor control rod, 18: 24974
fabrication of neutron shielding of, 18: 24079(P)
heat of formation at 298°C, 18: 23479
BORON CHLORIDE COMPLEXES
with ethyl cyanoacetate, preparation and spectra of, 18: 23471
BORON HYDRIDES
polarizability of closed cage $B_{10}H_{10}^{2-}$, 18: 23487
BORON ISOTOPES B-10
deuteron reactions (d,n) with, angular distributions and cross sections for, 18: 24611 (NP-13930(p.132-3))
deuteron reactions (d,Li^*) on, 18: 24625 (WASH-1046)
helium reactions (He-3,n) at 25 Mev, spectra of, 18: 24650
lithium reactions at 3.5 to 4.5 Mev, angular distributions for, 18: 24720
neutron reactions (n,α) in kev range, yield ratio for ground and excited states of lithium-7 from, 18: 24620(R) (ORNL-TM-874)
reactions with light nuclei at 105 Mev, dissociation in, 18: 24723
reactions with uranium-238 at 90 to 150 Mev, production of spontaneously fissioning isomer in, 18: 24725
separation from boron-11 by ion exchange, 18: 24055
BORON ISOTOPES B-11
deuteron reactions (d,n) with, angular distributions and cross sections for, 18: 24611 (NP-13930(p.132-3))
deuteron reactions (d,n) with, 18: 24625 (WASH-1046)
helium reactions (He-3,n) at 25 Mev, spectra of, 18: 24650
lithium reactions at 3.5 to 4.5 Mev, angular distributions for, 18: 24720
lithium reactions at 3 Mev, analysis of, 18: 24722
neutron capture resonance in, 18: 24625 (WASH-1046)
proton reactions $(p,2\alpha)$ with, interference effects in, 18: 24625 (WASH-1046)
range-energy relation in nuclear emulsions, 18: 24643
reactions (B-11,Be-9) and (B-11,Be-10) at 115.5 Mev, cross sections for, 18: 24715
reactions with light nuclei at 6.2 Mev, gamma spectra of transfer, 18: 24721
reactions with light nuclei at 115.5 Mev, dissociation in, 18: 24723
reactions with uranium-238 at 90 to 150 Mev, production of spontaneously fissioning isomer in, 18: 24725
separation from boron-10 by ion exchange, 18: 24055
BORON ISOTOPES B-12
lithium reactions at 3 Mev, analysis of, 18: 24722
BORON ISOTOPES B-13
lithium reactions at 3 Mev, analysis of, 18: 24722
BORON NITRIDES
development for high-temperature oxidation protection of tungsten, 18: 24086(R) (NP-13898)
BN–TiN, development for high-temperature oxidation protection of tungsten, 18: 24086(R) (NP-13898)
BORON OXIDES
spectra in low frequency region, infrared, 18: 23549
BORON SYSTEMS
B–Fe, radiation effects on stainless steel-clad, 18: 24195 (ORNL-TM-815)
B–Nb, electric and mechanical properties, 18: 24158
BOSONS
decay angular distributions of intermediate, leptonic-, 18: 24397 (NP-13954)
electromagnetic moments and leptonic decays of intermediate $W^{\pm}$, 18: 24464
lifetimes of massive triplets of, 18: 24467
BRAIN
radiation effects on postnatal development of cerebellum of, in mice, 18: 23284
radiation effects on cerebral cortex activity, x, 18: 23308
BRAKES
design of pneumatic, for reactor control rods, 18: 24834(P)
BREASTS
radiation- and hydrocarbon-induced tumors in rodent, 18: 23349
radioinduced tumors in rat, astatine-211, 18: 23261
BREEDER REACTORS
economics of, summary, 18: 24858(R) (HW-80560F)
fuel element design and processing, 18: 24929(P)
BREMSSTRAHLUNG
analysis of background tracks from, in nuclear emulsions, 18: 23930
cross sections at high-frequency limit, 18: 24426
efficiency in dog bones of strontium-90 plus yttrium-90, 18: 23173
emission from plasma, coefficients for, 18: 24792
polarization of fast positrons by, 18: 24435
production of double, in electron scattering by coulomb fields, 18: 24704
reactions (γ,p) with copper at 4 to 27 Mev, cross sections for, 18: 24
reactions with nuclei at 300 to 1000 Mev, fission cross sections for, 18: 24655
BRITISH REACTORS
control circuits for, 18: 24826
description of structural aspects of, 18: 24926
safety control measures for research, 18: 23810 (AERE-R-4528 (p.1-24))
BRITTLE MATERIALS
conference on application of high pressure in metal-deformation processing, Bureau of Naval Weapons, BMI, Columbus, Ohio, Oct. 3, 1963, 18: 24099 (DMIC-199)
BROMINE
neon-20 reactions at 200 Mev, mechanisms of, 18: 24732
BROMINE IONS
radiolysis effects on aqueous sulfuric acid solutions, 18: 23675
BROMINE ISOTOPES Br-77
gamma spectra, 18: 24585(R) (IDO-16969)
BROMINE ISOTOPES Br-80
meson (π^-) reaction, cross sections of particle production in, 18: 24 (JINR-P-1584)
BROMINE ISOTOPES Br-81
alpha scattering by, energy levels from, 18: 24620(R) (ORNL-TM
BUBBLE CHAMBERS
data analysis for, kinematic fitting program for, 18: 23877 (NIRL/M/
data analysis for, geometrical reconstruction computer program for,

18: 23887 (PAN-474/VI)
data processing for, device for ionization measurements on film and emulsions, 18: 24002
performance for particle detection, comparison with photographic emulsions, 18: 23906

BUBBLES
growth in liquid with initially uniform superheat, asymptotic, 18: 23774
radioinduced formation in uranium, effects of heating from 300 to 1000°C on, 18: 24187 (AERE-R-2935)

BUILDING MATERIALS
book: *Structures for Nuclear Power*, 18: 24926
design and construction of low-leakage reactor housing structures, 18: 24816(R) (NAA-SR-8888(Sect.IV))

BURNS
of the rabbit retina produced by electronically pulsed light source, 18: 23254

BUTADIENE, CHLORO- POLYMERS
radiation effects on, gamma and neutron, 18: 24937 (APEX-917)

1,3-BUTADIENE, 2-METHYL-
radioinduced polymerization of, gamma, 18: 23638(T,R) (AEC-tr-6316 (p.456-64))

BUTADIENE POLYMERS
structure of, from radioinduced polymerizations, 18: 23638(T,R) (AEC-tr-6316(p.456-64))

BUTANE, 2-METHYL-
radiolysis of, hydride ion transfer mechanisms in, 18: 23677

BUTANEDIOLS
radioinduced free radicals in, electron spin resonance studies of, 18: 23649(T,R) (AEC-tr-6316(p.538-50))

2,3-BUTANEDIONE
radioinduced polymerization of, gamma, 18: 23601(T,R) (AEC-tr-6316 (p.178-81))

1,3-BUTANEDIONE, 1-PHENYL-
with europium and terbium, laser action in, 18: 24229

1-BUTANETHIOL
effects on gamma-induced cis-trans transformation of natural rubber, 18: 23636(T,R) (AEC-tr-6316(p.444-8))

2-BUTANONE
radioinduced polymerization of, gamma, 18: 23601(T,R) (AEC-tr-6316 (p.178-81))
synthesis by radioinduced reactions of acetaldehyde with ethylene, 18: 23611(T,R) (AEC-tr-6316(p.253-60))

2-BUTENE
radioinduced additions of hydrogen sulfide to, yields in, 18: 23668
radioinduced isomerization of, effects of argon, diphenyl disulfide, ethyl bromide, iodine, and oxides on, 18: 23666
radioinduced isomerization on metallic oxides, 18: 23667

BUTYL PHOSPHATES
solvent properties for cerium, 18: 23727
solvent properties for uranyl nitrates, 18: 23738(P)
solvent properties for lanthanum nitrates, nitric acid, and water at 25°C, 18: 23712
solvent properties for uranyl nitrates, 18: 23713
solvent properties for americium, 18: 23719
solvent properties for protactinium, 18: 23720
HCl–TBP, solvent properties for californium, europium, fermium, and mendeleevium, 18: 23725
HNO_3–TBP, solvent properties for californium, europium, fermium, and mendeleevium, 18: 23725

BUTYL SULFIDES
effects on gamma-induced cis-trans transformation of natural rubber, 18: 23636(T,R) (AEC-tr-6316(p.444-8))

BUTYLAMINE
dissociation by electron bombardment, mass spectra from, 18: 23608(T,R) (AEC-tr-6316(p.232-7))

BUTYRIC ACID, 4-HYDROXY-
lactone, radioinduced polymerization with β-propiolactone, 18: 23605(T,R) (AEC-tr-6316(p.201-7))

C

CADARACHE REACTORS
design and operation, 18: 24967

CADARACHE REACTORS (RAPSODIE)
criticality studies on, in ZPR-III, 18: 24952(R) (ANL-6880(p.6-48))

CADMIUM
density of liquid, 18: 24813(R) (ANL-6880(p.49-67))
neutron scattering by, optical model analysis of, 18: 24625 (WASH-1046)
separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)
thermodynamic properties, 18: 24815(R) (MLM-1184)

CADMIUM ALLOYS
Bi–Cd, electrochemical properties, 18: 24815(R) (MLM-1184)
Cd–Li, performance in fuel cells, 18: 24355 (ANL-6802(p.53-63))
Cd–Mg–Zn, solvent properties for praseodymium, 18: 24952(R) (ANL-6880(p.6-48))

CADMIUM CHLORIDES
electric conductivity of melts, temperature coefficients for, 18: 23456(T) (Al-Trans-46)
Cd–$CdCl_2$, spectra and thermodynamics of gaseous equilibrium in, 18: 23483

CADMIUM ISOTOPES
oxygen-16 reactions with, coulomb excitation in, 18: 24620(R) (ORNL-TM-874)

CADMIUM ISOTOPES Cd-110
energy levels from silver-110m decay, 18: 24738

CADMIUM ISOTOPES Cd-114
energy levels of, random phase approximation for, 18: 24646

CADMIUM OXIDES
spectra in low frequency region, infrared, 18: 23549

CADMIUM SYSTEMS
Cd–$CdCl_2$, spectra and thermodynamics of gaseous equilibrium in, 18: 23483

CADMIUM TELLURIDES
photon absorption constants for, 18: 24356 (ANL-6802(p.64-5))

CALCIUM
determination in biological materials, activation, 18: 23418
neutron reactions at 14 Mev, gamma spectra from, 18: 24604 (NP-13930 (p.54-5))
neutron total cross sections at 8.58 to 11.59 Mev, 18: 24591(R) (LMSC-4-50-62-1)
separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)
separation from strontium by continuous electrophoresis, 18: 23721

CALCIUM CHLORIDES
protective effects against radiation damage to plant cells, 18: 23374
solvent properties of solutions of, for radium and uranium, 18: 23711

CALCIUM FLUORIDES
dysprosium and samarium ESR spectra in, 18: 23524
preparation of single crystals of, by zonal fusion, 18: 23460(T) (JPRS-24593(p.98-101))
rare earth EPR in, relaxation in, 18: 23526
rare earth EPR in, spin-lattice relaxation in, 18: 23527
CaF_2–CeF_3, formation and structure, 18: 23533
CaF_2–YF_3, formation and structure, 18: 23533

CALCIUM HYDROXIDES
effects on strontium-90 uptake by oats, 18: 23206(T) (JPRS-24290 (p.43-7))
sorptive properties for organic compounds, 18: 25032(T) (SC-T-64-618)

CALCIUM ISOTOPES Ca-40
alpha elastic scattering cross sections at 30.5 Mev, 18: 24583 (CONF-502-4)
deuteron reactions (d,p) at 11 Mev, finite-range effects in distorted-wave theory of, 18: 24667
deuteron reactions (d,^{3}He) with, angular distributions and cross sections for, 18: 24672
deuteron reactions (d,p) at 21 Mev, interference effects in, 18: 24713
deuteron reactions (d,p) on, angular distribution for, 18: 24625 (WASH-1046)
deuteron reactions (d,p) at 11.8 Mev, angular distributions for, 18: 24648
helium reactions (He-3,n) at 25 Mev, spectra of, 18: 24650
neutron capture cross section, 18: 24620(R) (ORNL-TM-874)

CALCIUM ISOTOPES Ca-43
neutron capture cross section, 18: 24620(R) (ORNL-TM-874)

CALCIUM ISOTOPES Ca-44
- alpha elastic scattering cross sections at 30.5 Mev, 18: 24583 (CONF-502-4)

CALCIUM ISOTOPES Ca-45
- tumorigenic effects in mice, 18: 23231(R) (ANL-6823(p.20-43))

CALCIUM ISOTOPES Ca-47
- effects of tetracycline on retention of, in mice and rats, 18: 23220
- uptake by man, liquid scintillation measurement of, 18: 23226

CALCIUM ISOTOPES Ca-48
- carbon-12 reactions with, cross sections for production of 4 and 6 neutron nuclei in, 18: 24616 (NP-13964)
- triton reactions with, cross sections for production of 4 and 6 neutron nuclei in, 18: 24616 (NP-13964)

CALCIUM OXALATES
- sorptive properties of europium, thorium, and yttrium, 18: 23714

CALCIUM OXIDES
- deposition on aluminum, electrolytic, 18: 23537
- dissociation energy of, mass spectrometric determination of, 18: 23455 (WADD-TR-60-782(Pt.XXII))
- sorptive properties for organic compounds, 18: 25032(T) (SC-T-64-618)
- spectra in low frequency region, infrared, 18: 23549
- BeO–CaO, crystallization in melts of, cooling rate dependence of, 18: 23562

CALCIUM PHOSPHATES
- sorptive properties for organic compounds, 18: 25032(T) (SC-T-64-618)
- $Ca_3(PO_4)_2$–humic acid, separation of radioisotopes from solutions by flocculation of, 18: 24982

CALCIUM TUNGSTATES
- ytterbium EPR in, 18: 23525

CALIFORNIUM
- separation from europium by solvent extraction using TBP–nitric acid and TBP–hydrochloric acid systems, 18: 23725

CALIFORNIUM ISOTOPES Cf-246
- yields in heavy ion reactions with thorium and uranium-22, 18: 24689

CALIFORNIUM ISOTOPES Cf-252
- fission of, statistics of prompt neutrons from spontaneous, 18: 24651

CALORIMETERS
- design for beta flux measurements, 18: 23893(T,R) (AEC-tr-6316 (p.24-30))

CANDU REACTOR
- fuel element failures in, detection of, 18: 24925
- loading machine for, development of on-power, 18: 24910(R) (SRO-101)

CAPROIC ACID
- photolysis in mixture with ammonium nitrate, formation of amino acids in uv, 18: 23204(T) (JPRS-24164(p.19-42))

CARBAMIC ACID, DIETHYLDITHIO-, SODIUM SALTS
- radiosensitivity effects on bean seedling roots, 18: 23379

CARBIDES
- book: *High-Temperature Materials.* No. 1, *Materials Index*, 18: 24075

CARBON
- carbon scattering at 127 Mev, excitation in, 18: 24710
- determination in liquid sodium, development of methods for, 18: 23411(R) (TID-20614)
- development of pyrolytic, as coating for reactor fuel particles, 18: 24988(R) (BMI-1665(Del.))
- effects on phase transformations in steel, 18: 24152(T,R) (EURAEC-1001)
- effects on stress corrosion of mild steel, 18: 24088(T) (AEC-tr-6394)
- elastic constants of polycrystalline, model for, 18: 23567
- electron and positron disintegration, 18: 24625 (WASH-1046)
- fabrication of impermeable composite tubes of, 18: 24117(P)
- lubrication of bearings of, 18: 23742 (TID-7690(p.106-20))
- meson (π^-) reactions with, gamma angular distributions from, 18: 24417
- meson (π^-) reactions at 7.5 Bev, 18: 24390 (JINR-P-1624)
- meson (π^-) reactions at 7 Bev, 18: 24391 (JINR-P-1629)
- meson (π^-) reactions in, parity conservation in hyperon (Λ^0) production in, 18: 24394 (NEVIS-122)
- neutron reactions $(n,n'\gamma)$ and $(n,2n)$ at 14 Mev, spectrometry of angular distributions from, 18: 24603 (NP-13930(p.51-3))
- neutron reactions at 14 Mev, gamma spectra from, 18: 24604 (NP-13930 (p.54-5))
- neutron slowing down in, use of Monte Carlo method for, 18: 24996(R) (NAA-SR-8888(Sect.VI))

CARBON BLACK
- free radicals in, electron spin resonance studies of, 18: 23401(T,R) (AEC-tr-6316(p.660-8))

CARBON DIOXIDES
- effects on dynamic decomposition of rare earth oxalates, 18: 23507
- effects on gamma-induced insect sterility, 18: 23276
- isotope exchange with its ethanolamine solutions, 18: 24052(T) (ORNL-tr-68)
- isotope exchange with potassium bicarbonate, effects of solution flow rate on, 18: 24053(T) (ORNL-tr-69)
- neutron scattering by, near critical point, 18: 24625 (WASH-1046)
- oxygen-18 exchange with water in moisture determination in cellulose, 18: 23397(T,R) (AEC-tr-6316(p.274-82))
- radioinduced oxygen-18 exchange with carbon dioxide, beta, 18: 23609(T,R) (AEC-tr-6316(p.238-44))
- temperatures behind reflected shock waves, 18: 24236
- use as carrier gas in radon sorption studies on wood charcoal, 18: 23462(T) (SC-T-64-616)

CARBON IONS
- scattering on carbon at 127 Mev, excitation in, 18: 24710

CARBON ISOTOPES
- separation by exchange between carbon dioxide and ethanolamine solutions, 18: 24052(T) (ORNL-tr-68)
- separation by exchange in carbon dioxide-potassium carbonate system, effects of solution flow rate on, 18: 24053(T) (ORNL-tr-69)

CARBON ISOTOPES C-11
- hyperfine structure and nuclear moments of, 18: 24622 (PUC-1963-12)

CARBON ISOTOPES C-12
- alpha clusters in, reduced widths for, 18: 24588 (JINR-P-1595)
- alpha reactions (α,p) at 30.5 Mev, differential cross sections for, 18: 24687
- alpha scattering at 6 to 19 Mev, analysis of, 18: 24712
- boron reactions (B-11,Be-9) and (B-11,Be-10) at 115.5 Mev, cross sections for, 18: 24715
- carbon reactions $(C\text{-}12,\alpha)$ at 9 to 15.6 Mev, angular distributions for, 18: 24724
- deuteron reactions (d,Li-6) at 15 Mev, angular distributions for, 18: 24714
- deuteron reactions (d,n) with, 18: 24625 (WASH-1046)
- deuteron reactions (d,p) at 11.8 Mev, angular distributions for, 18: 24
- deuteron scattering at 70 Mev, data processing for sonic spark chamber experiment on, 18: 24000
- electron inelastic scattering at 40 to 70 Mev, excitation of E1 giant resonance in, 18: 24671
- electron inelastic scattering at 40 to 70 Mev, M1 transitions following, 18: 24675
- electron inelastic scattering at 40 to 70 Mev, M1 transitions following, 18: 24676
- electron inelastic scattering by, form factors for magnetic dipole, 18: 24625 (WASH-1046)
- helium reactions (He-3,n) at 25 Mev, spectra of, 18: 24650
- ion reactions at 36 to 115.5 Mev, dissociation in, 18: 24723
- lithium-7 elastic scattering at 7.3 Mev, differential cross sections in, 18: 24325
- meson (π^-) reaction, cross sections of particle production in, 18: 24 (JINR-P-1584)
- neutron reactions (n,n') with, at 15 to 80 Mev, 18: 24642
- nitrogen reactions $(N\text{-}14,\alpha)$ at 27 Mev, angular momentum effects in, 18: 24726
- oxygen-16 scattering at 168 Mev, excitation in, 18: 24709
- reactions (C-12,7n) with neodymium-144 at 108 Mev, recoil ranges in, 18: 24734
- reactions with calcium-48, cross sections for production of 4 and 6 neutron nuclei in, 18: 24616 (NP-13964)
- reactions with rare earths, effective charge distribution from, 18: 24 (UCRL-10806)
- scattering by lead-208 at 125 Mev, excitation in inelastic, 18: 247
- scattering by nitrogen-14 and oxygen-16, cross sections for elastic, 18: 24674

CARBON ISOTOPES C-13
- alpha reactions (α,n) with, 18: 24625 (WASH-1046)

- deuteron reactions (d,n) with, neutron polarization in, 18: 24625 (WASH-1046)
- deuteron reactions (d,p) with, 18: 24625 (WASH-1046)
- exchange between carbon disulfide and xanthogenate, 18: 24057(P)
- helium reactions (He-3,n) at 25 Mev, spectra of, 18: 24650
- ion reactions at 6.2 and 9.6 Mev, gamma spectra of, 18: 24721
- range-energy relation in nuclear emulsions, 18: 24643

CARBON ISOTOPES C-14

- deuteron reactions (d,n) with, 18: 24625 (WASH-1046)
- energy levels, 18: 24625 (WASH-1046)
- incorporated in methionine, radiation effects on uptake by rat tissues of, x, 18: 23293
- incorporation in phenobarbital, 18: 23568 (CEA-R-2406)
- uptake by fresh-water fish, 18: 23223

CARBON MONOXIDES

- radiosensitivity effects in white rats, x, 18: 23383

CARBON STEEL

- corrosion by water, oxide film tenacity and release of retained film radioactivity in, 18: 24082 (HW-79811)
- welding of, Hanford guide for, 18: 24102 (TID-20625(Vol.I))
- welding of, Hanford guide to procedures and specifications for, 18: 24103 (TID-20625(Vol.II))
- welding of, Hanford guide to procedures, specifications, and qualification test records for, 18: 24104 (TID-20625(Vol.III))

CARBON SULFIDES

- CS$_2$–xanthogenate, carbon-13 enrichment and exchange in, 18: 24057(P)

CARBON SYSTEMS

- Be–C–U, fabrication by casting, extrusion, and splat cooling, 18: 24066(R) (NMI-2126)
- Be–C–U, fabrication and properties of cast, extruded, and splat-cooled, 18: 24067(R) (NMI-2127)
- Be–C–U, hardness of cast, extruded, and splat-cooled, at 500 and 600°C, 18: 24066(R) (NMI-2126)
- C–Mo–Nb–W–Zr, corrosion by potassium at 2000 to 2200°F, 18: 24091
- C–Nb–W–Y–Zr, corrosion by potassium at 2000 to 2200°F, 18: 24091
- C–Pu–U, performance as zero-power reactor fuel, 18: 24952(R) (ANL-6880(p.6-48))
- C–Th–U, hardness of (Th,U)C and (Th,U)C$_2$, at 25 to 1500°C, 18: 24988(R) (BMI-1665(Del.))

CARBON TETRACHLORIDE

- radioinduced addition to 1-octene, 18: 23659(T,R) (AEC-tr-6316 (p.669-71))

CARBONATES

- poly-, radioinduced free radicals in, electron spin resonance studies of, 18: 23646(T,R) (AEC-tr-6316(p.522-5))

CARCINOGENESIS

- induction by radiation and hydrocarbons in rodents, 18: 23349

CARCINOGENS

- effects on soluble nuclear proteins in rats, 18: 23192(R) (ANL-6823 (p.124-7))

CAROLINAS-VIRGINIA TUBE REACTOR

- operation of, Apr. 1964, 18: 24910(R) (SRO-101)
- operation, Oct. 1963–Mar. 1964, 18: 24879(R) (CVNA-204)

CAROTENE

- radioinduced free radicals in, singlets in electron spin resonance spectra produced at high doses, 18: 23616(T,R) (AEC-tr-6316(p.306-9))
- radioinduced free radicals in, oxidation of, 18: 23619(T,R) (AEC-tr-6316 (p.322-5))

CARTILAGE

- ossification of, biochemical and physical processes in, 18: 23188(R) (ANL-6823(p.102-4))
- proteinpolysaccharide degradation from, 18: 23217

CATALASES

- inhibition by 5-mercapto-1,2,3,4-tetrazole in mice, 18: 23187(R) (ANL-6823(p.91-8))
- levels in mouse erythrocytes, reduction of, 18: 23186(R) (ANL-6823 (p.86-90))

CATARACTS

- radioinduced in man, 18: 23313
- radioinduced, in frogs, seasonal variations in, 18: 23268

CATION EXCHANGE MATERIALS

- phosphoric acid resins as, selectivity coefficients of, for cesium, lithium, potassium, rubidium, and sodium as function of acidity, 18: 23481
- properties of sulfostyrene, 18: 23736

CATTLE

- iodine-131 and strontium-89 and -90 in milk of, 18: 23829
- radiation effects on primitive germ cells in testes of prepubertal, gamma, 18: 23278
- radiation effects on spermatozoa metabolism in, gamma, 18: 23297
- radiation effects on semen in, after testicular irradiation, 18: 23337

CAVES

- design for dividing and bottling radioactive solutions, 18: 23757(P)
- remote-control pipetters for, design and performance of, 18: 23842 (UCRL-9661)

CAVITY RESONATORS

- noise removal by, space-charge fast-wave, 18: 23848
- performance of, using superconductors, 18: 24559
- plasma diagnostics in, 18: 24745 (ANL-6802(p.120-5))

CELLOBIOSE

- radioinduced free radicals in, gamma, 18: 23651(T,R) (AEC-tr-6316 (p.573-86))

CELLULOSE

- acetyl-, radioinduced free radicals in, gamma, 18: 23651(T,R) (AEC-tr-6316(p.573-86))
- moisture determination in viscose rayon, use of oxygen-18 exchange reaction with carbon dioxide in, 18: 23397(T,R) (AEC-tr-6316 (p.274-82))
- radioinduced free radicals in, electron spin resonance study of, 18: 23588(T,R) (AEC-tr-6316(p.100-4))
- radioinduced free radicals in, concentration of, 18: 23618(T,R) (AEC-tr-6316(p.314-21))
- radioinduced free radicals in, gamma, 18: 23651(T,R) (AEC-tr-6316 (p.573-86))
- radioinduced graft polymerization of styrene on, gamma, 18: 23585(T,R) (AEC-tr-6316(p.84-8))
- radioinduced graft polymerization of styrene on preirradiated, 18: 23586(T,R) (AEC-tr-6316(p.89-94))
- radioinduced graft reactions of preirradiated, effects of atmosphere on, 18: 23587(T,R) (AEC-tr-6316(p.95-9))
- radioinduced graft polymerization of styrene on viscose, gamma, 18: 23643(T,R) (AEC-tr-6316(p.498-500))
- radioinduced graft polymerization of vinyl monomers on, gamma, 18: 23658(T,R) (AEC-tr-6316(p.650-9))
- sorptive properties for organic compounds, 18: 25032(T) (SC-T-64-618)

CELLULOSES

- bentonite–diethylaminoethyl cellulose, use as flocculation agent for ruthenium in waste solutions, 18: 24983
- bentonite–phosphoryl cellulose, use as flocculation agent for ruthenium in waste solutions, 18: 24983

CENTRIFUGATION

- of Pelomyxa nucleoplasm, 18: 23197(R) (ANL-6823(p.169-73))
- plutonium colloidal state determination using, 18: 23190(R) (ANL-6823(p.111-13))

CERAMIC COATINGS

- development for Haynes 25 Alloy and type 316 stainless steel, 18: 24085(R) (NASA-CR-54053)

CERAMIC MATERIALS

- book: *High-Temperature Materials*. No. 1, *Materials Index*, 18: 24075
- thermodynamic and mechanical properties of, data compilation on, 18: 24141 (RTD-TDR-63-4102)

CERIUM

- additive effects on radiation resistance of potassium-aluminoborate glass, 18: 24813(R) (ANL-6880(p.49-67))
- magnetic properties of, effects of crystalline field and structure on, 18: 24186
- oxidation to tetravalent state, by ozone or electrolysis, 18: 23727
- polarographic behavior in tetraethylammonium bromide at dropping mercury electrode, 18: 23463
- reaction with potassium sulfate crystals, 18: 23539
- separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)
- separation from other fission products by solvent extracts, 18: 23727

CERIUM ALLOYS

Ce–Co–Pu, thermodynamic properties of liquid and solid, 18: 24815(R) (MLM-1184)
Ce–Cu–Pu, phase studies, 18: 24815(R) (MLM-1184)
Ce–Ni, phase studies, 18: 24815(R) (MLM-1184)
Ce–Ni–Pu, phase studies, 18: 24815(R) (MLM-1184)
Ce–Pu, phase studies, 18: 24815(R) (MLM-1184)

CERIUM FLUORIDES
CaF_2–CeF_3, formation and structure, 18: 23533

CERIUM IONS
electron paramagnetic resonance in calcium fluorides, relaxation in, 18: 23526
electron paramagnetic resonance in calcium fluorides, spin-lattice relaxation in, 18: 23527
radiolysis effects on aqueous sulfuric acid solutions, 18: 23675
spectra of trivalent, in borax and silica glass, infrared, 18: 23459(T) (JPRS-24593(p.37-41))

CERIUM ISOTOPES Ce-143
production in neon-22 and oxygen-18 reactions with thorium-232, 18: 24690

CERIUM ISOTOPES Ce-144
beta spectra, 18: 24222
body burdens in beagle, 18: 23184(R) (ANL-6823(p.44-75))
deposition on stainless steel in fuel element processing, 18: 23705 (ORNL-TM-837)
determination in bone, radiochemical, 18: 23402 (AERE-R-4466)
metabolism, 18: 23816 (AHSB(S) R-64)
metabolism in miniature swine, 18: 23200 (HW-SA-3350)
separation by calcium phosphate–humic acid flocculation, 18: 24982
shipping of, design and hazards evaluation of cask for, 18: 23823 (HW-65268)

CERIUM OXALATES
dynamic decomposition of, effects of air, carbon dioxide, and nitrogen on, 18: 23507

CERIUM OXIDES
catalytic effects on deuterium, exchange in cyclohexane, 18: 23573
spectra in low frequency region, infrared, 18: 23549
stoichiometry in CeO_{2-x}, 18: 23516
CeO_2–Ce_2O_3–ThO_2, phase studies on, 18: 23516
CeO_2–Dy_2O_3, equilibrium phase studies on, 18: 23509
CeO_2–Gd_2O_3, equilibrium phase studies on, 18: 23509
CeO_2–Ho_2O_3, equilibrium phase studies on, 18: 23509
CeO_2–La_2O_3, equilibrium phase studies on, 18: 23509
CeO_2–Nd_2O_3, equilibrium phase studies on, 18: 23509
CeO_x–O_2, phase studies, 18: 23505
CeO_2–Sm_2O_3, equilibrium phase studies on, 18: 23509
CeO_2–ThO_2–Y_2O_3, phase studies on, 18: 23516
CeO_2–Yb_2O_3, equilibrium phase studies on, 18: 23509
CeO_2–Y_2O_3, equilibrium phase studies on, 18: 23509
CeO_2–ZrO_2, crystal structure, differential thermal analysis, and thermal expansion of, 18: 23503

CESIUM
alloying effects in molybdenum–rhenium thermionic cells, 18: 24350(R) (AD-418276)
electron elastic scattering cross sections at low energies, 18: 24298 (N64-13373)
fixation by clay minerals, effects of various cations on, 18: 23548
flow in ion engines, feed system for, 18: 23754 (NASA-CR-51)
performance as propellant in spacecraft ion engines, 18: 23740(R) (NP-13899)
performance in thermionic cells, 18: 24360 (ANL-6802(p.126-43))
performance in thermionic cells, 18: 24362 (ANL-6802(p.152-60))
separation from pollucite ore by chlorination at 550 to 700°C, 18: 24991 (IS-884)
separation from rubidium by electrophoresis in ammonium paratungstate, tracer studies of, 18: 23729
separation from rubidium by electrophoresis, tracer studies of, 18: 23730
separation from waste solutions by ion exchange, 18: 23700 (DP-876)
sorption by phosphoric acid resins, effects of acidity on selectivity coefficients for, 18: 23481
sorption by potassium and sodium zeolites, selectivity coefficients for, 18: 23480
use in photomultiplier tubes, 18: 23865

CESIUM AMIDES
catalysis of isotopic exchange between liquid ammonia and hydrogen by, 18: 24058(P)

CESIUM CHLORIDES
electric conductivity of melts, temperature coefficients for, 18: 23456(T) (AI-Trans-46)
preparation from pollucite ores by chlorination at 550 to 700°C, 18: 24991 (IS-884)
proton relaxation times in aqueous solutions of, 18: 23559
reactions with lead chlorides and strontium-90 to form complex crystals, 18: 23540

CESIUM FLUORIDES
additive effects in molybdenum–rhenium thermionic cells, 18: 24350(R) (AD-418276)

CESIUM ISOTOPES Cs-132
gamma spectra, 18: 24585(R) (IDO-16969)

CESIUM ISOTOPES Cs-134
detection of, 18: 23389

CESIUM ISOTOPES Cs-137
content in mushrooms, 18: 23183
content in Swedish food, 1962, 18: 23790 (NP-13828)
deposition on stainless steel in fuel element processing, 18: 23705 (ORNL-TM-837)
determination in bone, radiochemical, 18: 23402 (AERE-R-4466)
dietary effects on mortality, reproduction, and tumor tolerance in mice, 18: 23210
distribution in milk products, 18: 23800
metabolism, 18: 23816 (AHSB(S) R-64)
separation by calcium phosphate–humic acid flocculation, 18: 24982
sources for radiotherapy, 18: 23389
uptake by Alaskan Eskimos, 18: 23834

CESIUM NITRATES
complexes with uranyl nitrates, infrared spectra and structure of, 18: 23535

CHARCOAL
sorptive properties for iodine vapors in gas streams, effects of steam, temperature, and flow rate on, 18: 23386 (CONF-12-3)
sorptive properties of activated, for radon in presence of foreign gases, 18: 23462(T) (SC-T-64-616)
sorptive properties for radioiodine, 18: 23828(R) (UCRL-7637)
sorptive properties of activated, for radon in open system of free gas flow, 18: 25031(T) (SC-T-64-617)
use of, in storing radiosterilized meat, 18: 23271

CHARGED PARTICLE BEAMS
focusing and directing apparatus for accelerators, 18: 24267(P)
focusing in transaxial electric and magnetic fields, 18: 24262
transfer from injector synchrotron to synchrotron, synchronization of rf, 18: 24240 (CERN-64-20)

CHARGED PARTICLES
detection and measurement by ionographic emulsion, 18: 23909
detection and measurement by nuclear emulsion, 18: 23910
detection and measurement of high-energy, using nuclear emulsion, 18: 23911
detection and measurement using nuclear emulsion, 18: 23912
detection and measurement by nuclear emulsion, 18: 23913
detection and measurement using nuclear emulsion, 18: 23914
detection of relativistic, spark chambers for, 18: 23874 (JINR-P-1619)
detection of, track spark chambers for, 18: 23968
dynamics of, review on, 18: 24764 (UTIAS-Rev-18)
electromagnetic field from, in moving dispersive medium, 18: 24484(T) (JPRS-24633(p.275-80))
interactions of relativistic, with bound electrons in emulsion, 18: [illegible]
interactions with stationary current distribution, Aharonov-Bohm quantum mechanical paradox in, 18: 24503
momentum of high-energy, determination using emulsions, 18: 23945
motion in circular accelerator with azimuthally periodic magnetic field, equations for, 18: 24257
motion in electric fields, equations for, 18: 24509
production in meson (π^-) absorption in propane, spectra of, 18: 24475
radiation from, passing through diffuse, interface, 18: 24480
reactions with plasma, energy losses in, 18: 24802

scattering by cobalt and nickel isotopes, elastic, 18: 24625 (WASH-1046)
shielding against, electrostatic, 18: 24807
spectra of, design of spectrometer with silicon surface-barrier detector for, 18: 23962
wave functions for low-energy, coulomb, 18: 24682

CHEMICAL PROPHYLAXIS
effects of radiation, on bean roots, 18: 23379

CHEMICAL RADIATION DETECTORS
use of polyvinyl chloride films for beta dosimetry, 18: 23894(T,R) (AEC-tr-6316(p.46-58))

CHEMISTRY
bibliography on, of zirconium aqueous solutions, 18: 23472
research progress in, in Communist China, selected translations on, 18: 25025(T) (JPRS-24552)
research progress in Communist China, selected translations on, 18: 25026(T) (JPRS-24593)

CHERENKOV DETECTORS
design for high energy electrons, 18: 23895
development of plastic, 18: 23975
performance for particle detection, comparison with photographic emulsions, 18: 23906

CHICKENS
radiation effects on embryos of, gamma, 18: 23229(R) (ANL-6823(p.5-14))

CHINON REACTORS (EDF-1)
startup measurements, 18: 24921

CHLORAL
radiation effects on electric conductivity of, dose rate effects in gamma, 18: 23663
radioinduced polymerization of, gamma, 18: 23634(T,R) (AEC-tr-6316 (p.442))

CHLORELLA
plastid development and chlorophyll production in C-10 mutant of, 18: 23196(R) (ANL-6823(p.161-4))

CHLORIC ACID
diffusion into polymers, 18: 25022(T) (ANL-Trans-15)

CHLORIDE IONS
determination in beryllium solutions by cation exchange, 18: 23423

CHLORIDES
determination in VBWR coolant, 18: 24886(R) (GEAP-4565)
determination in VBWR coolant, 18: 24884(R) (GEAP-4419)
free energies of interaction of metal-metallic salt systems, 18: 24996(R) (NAA-SR-8888(Sect.VI))
wetting properties of molten, on graphite and metals, sessile drop observations of, 18: 23437 (CONF-322-12)

CHLORINE
radioinduced reactions with acetylene at low temperatures, 18: 23629(T,R) (AEC-tr-6316(p.436))
reactions with pollucite ores at 550 to 700°C, cesium separation by, 18: 24991 (IS-884)

CHLORINE IONS
radiolysis effects on aqueous sulfuric acid solutions, 18: 23675
Cl–O–H_2O, corrosive effects on 304 and 347 stainless steels, 18: 24125(R) (CEND-3256-209)

CHLORINE ISOTOPES Cl-34
gamma spectra of metastable and ground-state, 18: 24585(R) (IDO-16969)

CHLORINE ISOTOPES Cl-35
meson (π^-) reaction, cross sections of particle production in, 18: 24587 (JINR-P-1584)
nitrogen reactions (N-14,N-15) and (N-14,O-15) at 27.5 Mev, excitation functions for, 18: 24716

CHLORINE ISOTOPES Cl-37
neutron capture, 18: 24625 (WASH-1046)
proton reactions (p,n) with, 18: 24625 (WASH-1046)

CHLOROFORM
radioinduced addition to 1-octene, 18: 23659(T,R) (AEC-tr-6316 (p.669-71))

CHLOROPHYLLS
production in Chlorella, 18: 23196(R) (ANL-6823(p.161-4))
radioinduced mutants affecting Phaseolus, x, 18: 23263

CHLOROPLASTS
production in Chlorella, 18: 23196(R) (ANL-6823(p.161-4))
radiation effects on, in *Chara vulgaris* algae, 18: 23287
triphosphopyridine nucleotide reduction and adenosine triphosphate formation by spinach, 18: 23198(R) (ANL-6823(p.191-8))

CHLOROTRIANISENE
protective effects against radiation injuries, 18: 23371

CHLORTETRACYCLINE
radiosensitivity effects of, effects of activation on, 18: 23380

CHOLESTEROL
radiation effects on content of, in adrenal glands, 18: 23322

CHOLINE, ACETYL-
effects on cholesterol content of adrenal glands in rats during radiation sickness, 18: 23322
effects on protein metabolism in adrenal glands of irradiated guinea pigs, 18: 23321

CHROMATOGRAPHY
equipment for analysis of superheated steam for gases by, 18: 23407 (DP-880)
FORTRAN program for two-component, 18: 23195(R) (ANL-6823 (p.152-6))
methods of paper, for separation of rare earths, 18: 23715
of dual-labeled compounds, calculation of isotope separation factors for, 18: 23194(R) (ANL-6823(p.141-51))
use in organic chemistry, 18: 25032(T) (SC-T-64-618)
uses for separation of selenium from irradiated strontium oxide, 18: 23731
uses in separating radioisotopes, 18: 23732
uses in separation of arsenic and germanium phenyl derivates, 18: 23733

CHROMIUM
effects on phase transformations in steel, 18: 24152(T,R) (EURAEC-1001)
neutron scattering by, 18: 24625 (WASH-1046)
separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)

CHROMIUM ALLOYS
Cr–Cu–Fe–Mo–Ni, performance of Ni–O–Nel 825 in nuclear superheater environment, 18: 24886(R) (GEAP-4565)
Cr–Fe–Ni, performance of Incoloy, Incoloy 800, Incoloy 801, and Ni–O–Nel in nuclear superheater environment, 18: 24886(R) (GEAP-4565)
Cr–Fe–Ni, performance of Incoloy, Incoloy 800, Ni–O–Nel, and RA 330 in nuclear superheater environment, 18: 24884(R) (GEAP-4419)
Cr–Nb, electric and mechanical properties, 18: 24158
Cr–Nb–Ti–V, properties for use as cladding materials in nuclear superheat applications, 18: 24080 (BMI-X-286)
Cr–Ni, creep and corrosion tests on fuel sheets of, 18: 24939(R) (GEMP-285)

CHROMIUM COMPOUNDS
preparation of plutonate, with perovskite structure, 18: 23521(P)

CHROMIUM ISOTOPES
energy levels, 18: 24625 (WASH-1046)

CHROMIUM ISOTOPES Cr-49
gamma spectra, 18: 24585(R) (IDO-16969)

CHROMIUM ISOTOPES Cr-50
proton reactions (p,γ) with, energy levels of manganese-51 from, 18: 24660

CHROMIUM ISOTOPES Cr-52
deuteron reactions (d,p) at 8 Mev, finite range effects in, 18: 24686
deuteron reactions (d,d) and (d,p) with, 18: 24625 (WASH-1046)
proton reactions (p,γ) with, energy levels of manganese-53 from, 18: 24660

CHROMIUM OXIDES
catalytic effects on radioinduced isomerization of 2-butene, 18: 23667
effects on radiation behavior of polymers, 18: 24199(T,R) (AEC-tr-6316 (p.359-67))
spectra in low frequency region, infrared, 18: 23549

CHROMIUM STEEL
ductility of, effects of hydrogen on, 18: 24153(T,R) (EURAEC-1002)
performance of Croloy in nuclear superheater environment, 18: 24884(R) (GEAP-4419)
Croloy–Ti, performance in nuclear superheater environment, 18: 24884(R) (GEAP-4419)

CHROMIUM SYSTEMS
Cr–Si–Ti, protective effects on B-66 and D-43 niobium alloys, 18: 24068(R) (NP-13955)

CHROMOSOMES
autoradiographic identification of, after administration of tritiated thymidine to cells in tissue culture, 18: 23201 (LFEN-N1.11)
morphology of isolated mammalian during metaphase, 18: 25008 (TID-19032)
radiation injury in mice testes, protection against, using streptomycin, 18: 23359(T) (JPRS-24593(p.120-5))
radioinduced aberrations in Rhesus monkey during spermatogenesis, gamma, 18: 23317
CIRCUITS
amplitude-to-time converter for pulse-height analyzers, 18: 23852
analog-to-digital converter for pulse analysis, sliding-scale, 18: 23851
applications of fast circuitry in nuclear physics, 18: 24014
applications of micrologic, in nuclear instrumentation, 18: 23850
description of fast transistorized logical, for synchrotrons, 18: 24266
description of fast tunnel diode monostable multivibrator triggering, 18: 23863
description of four-channel digital commutator for single output, 18: 23855
design for triggering sonic spark chambers, 18: 23999
fabrication of printed-board, radiotracers in, 18: 23841 (TID-20183)
resolution systems for photomultipliers and solid-state detectors, 18: 23995
review of reactor-control, 18: 24826
theory, 18: 24516(T) (JPRS-24633)
CITRIC ACID
photolysis in mixture with ammonium nitrate, formation of amino acids in uv, 18: 23204(T) (JPRS-24164(p.19-42))
CIVIL ENGINEERING
book: *Structures for Nuclear Power*, 18: 24926
CIVILIAN DEFENSE
evaluation of protection afforded by wood-frame houses and group shelters, 18: 23826 (NP-13942)
CLAYS
cesium fixation by, effects of various cations on, 18: 23548
radiation effects on, electron and gamma, 18: 23171
sorptive properties for waste solutions, 18: 24980(T,R) (EURAEC-300)
CLOTHING
radium-226 decontamination of, method for, 18: 23830
CLOUD CHAMBERS
use in cosmic particle detection and measurement, 18: 24346
CLOUDS
formation by shock-wave interaction between solar radiation and comets, 18: 24282
COATINGS
deposition of irradiated polymeric, 18: 23400(P)
development for high-temperature oxidation protection of tungsten, 18: 24086(R) (NP-13898)
thickness measurements by gamma excitation of x-ray fluorescence, 18: 24046 (PAN-485/I-A)
COBALT
neutron capture gamma spectra, 18: 24625 (WASH-1046)
neutron scattering by, 18: 24625 (WASH-1046)
neutron total cross section of, 18: 24625 (WASH-1046)
separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)
COBALT ALLOYS
Ce–Co–Pu, thermodynamic properties of liquid and solid, 18: 24815(R) (MLM-1184)
Co–Sc, crystal structure of, 18: 24157
COBALT ISOTOPES Co-60
use in weighing systems for moving vehicles, 18: 24027(P)
COBALT OXIDES
spectra in low frequency region, infrared, 18: 23549
COBALT SYSTEMS
Co–WC, structure of, 18: 24175
COINCIDENCE CIRCUITS
applications of fast circuitry in nuclear physics, 18: 24014
design for two-fold coincidence outputs, 18: 23844
development of anti-, for detection of hyperons (Λ^0), 18: 24006
use of photomultiplier as element of coincidence selection, 18: 24013
COINCIDENCE COUNTERS
design, 18: 23886 (NP-13965)
design, 18: 23892 (USNRDL-TR-729)
COLUMBIA RIVER
effects on zinc-65 uptake by euphausiids off Oregon coast, 18: 23182
COMETS
interactions with solar corpuscular streams, 18: 24282
COMPLAMIN
therapy of x-radiation injuries in mice using, 18: 23365
COMPRESSORS
development of gas-bearing, 18: 23744 (TID-7690(p.219-35))
development of high-temperature helium, 18: 23745 (TID-7690(p.236-44))
COMPUTER PROGRAMS
ARGUS, for transient temperatures in multiregion axisymmetric cylindrical configurations, 18: 23763 (ANL-6654)
B692/RP, for first-flight collision probabilities for cylindrical lattices, FORTRAN for IBM-704, 18: 24844 (ANL-6836)
CEP, for calculating collision probabilities in cuboids and cylinders, 18: 24377 (AEEW-M-442)
CRAMP, for matrix manipulation, 18: 24060 (KAPL-M-6148)
DEEMS, for solving first-degree coupled differential equations by matrix expansion, FORTRAN, 18: 24061 (TDSI-49)
development of, procedures for, 18: 24992 (IS-904)
ELMOE, for criticality studies in ZPR-III, 18: 24813(R) (ANL-6880 (p.49-67))
ELMOE, for elastic scattering resonances in fast reactors, 18: 24811 (ANL-6805)
for analysis of one-dimensional flow of real gases, FORTRAN-II, 18: 23772 (UCRL-7530)
for neutron activation integrals in slab geometries, FORTRAN for IBM-704, 18: 23871 (ANL-6822)
for simulating a two-component chromatogram with or without contaminant, 18: 23195(R) (ANL-6823(p.152-6))
for thermodynamic analysis of vapor plating reactions, 18: 23451 (UCRL-7667)
FORDRAM, for calculating group average microscopic resonance absorption and fission cross sections, 18: 24589 (KAPL-M-6131)
GRAPH, for curve plotting with Philco 2000, 18: 24059 (KAPL-M-6144)
GROD, for producing graphs of nuclear library data, 18: 24987 (AEEW-M-426)
PIP1, for solving multigroup equations of collision probabilities, 18: 24378 (AEEW-R-326)
SAP, for predicting hydrodynamic flow oscillations in heated channel, 18: 23767 (KAPL-M-6149)
SIUP, geometrical reconstruction analysis of bubble chamber tracks, 18: 23887 (PAN-474/VI)
STEAM, for processing digitized spark chamber data, 18: 23872 (BNL-833)
SYMMETRY PROJECTION, for calculation of crystalline symmetry matrices in FORTRAN, 18: 24296(R) (AD-417517)
TOTEFF, for calculating neutron detection efficiency of plastic scintillator, 18: 23891 (UCRL-11339)
WIGLE, for solving two-group space-time diffusion equations in slab geometry, 18: 24572 (WAPD-TM-416)
COMPUTERS
curve fitting, integration and interpolation programs for Philco 2000, 18: 24993 (KAPL-M-6139)
programming of, procedures for, 18: 24992 (IS-904)
use in multiparameter measuring-registering analytical center for nuclear physics, 18: 23861
use in reactor control data processing by numerical units, 18: 2482
use of CDC 160-A and CDC 603 on-line for multiparameter-multichannel analysis of gamma-gamma coincidences and neutron time-of-flight measurements, 18: 23859
use of digital, for analysis of one-dimensional flow of real gases, 18: 23772 (UCRL-7530)
use of digital, in multiparametric analyses in nuclear physics, 18: 24
use of IBM 1401, for automatic record of film badge data, 18: 23818 (AWRE-O-93/63)
use of IBM 1620 in control of neutron spectrometer, 18: 24009
use of PB 440 in integrated computer-analyzer system for multiparameter data from accelerators, 18: 23860
use of PDP-1 on-line with pulse-height analyzers, 18: 23858

use with multichannel analyzers, data transmission in, 18: 24010
uses for analyses of crystal and molecular properties, 18: 24296(R) (AD-417517)

CONCRETES
book: *Structures for Nuclear Power,* 18: 24926
design and construction of low-leakage reactor housing structures, 18: 24816(R) (NAA-SR-8888(Sect.IV))
development for nuclear power structures, 18: 24926
properties of prestressed, as reactor pressure vessels, 18: 24825

CONFERENCES
Compact Reactor Technology, Baltimore, Nov. 14, 1963, 18: 24895 (NP-13900)
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index to, relating to nuclear science, 1957 through 1963, 18: 25005 (TID-4043(Rev.1))
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Nuclear Electronics International Symposium, Paris, Nov. 25 to 27, 1963, 18: 23970
Particle Photography, Fourth International Colloquium on, Munich, 1963, 18: 23904
Reactions Between Complex Nuclei, Third Conference on, Asilomar, April 1963, 18: 24707
Rotating Machinery for Gas-Cooled Reactor Application, Gatlinburg, Tenn., Nov. 1963, 18: 24911 (TID-7690)

CONNECTORS (ELECTRIC)
electric conductivity of thermoelectric cell, 18: 24357 (ANL-6802 (p.78-86))
radiation effects on, neutron, 18: 24822 (PWAC-427)

CONVERSION ELECTRONS
detection and measurement using energy-selective semiconductor detectors, isomeric lifetimes from, 18: 24025
spectra at 0 to 20 kev. 18: 24408

COPPER
bremsstrahlung reactions (γ,p) at 4 to 27 Mev, cross sections for, 18: 24698
coating with radioactive rare earth for use as radiation source, 18: 24056
determination in small solid samples by mass spectroscopy, design of ion source for, 18: 23406 (CONF-512-4)
diffusion of antimony-124 in monocrystals of, 18: 23522
diffusion of interstitial atoms and empty spaces in, 18: 25029(T) (ORNL-tr-92)
gamma scattering at 280 kev, small-angle, 18: 24412
neutron capture gamma spectra, 18: 24625 (WASH-1046)
neutron reactions (n,γ) with, gamma spectra of fast and thermal, 18: 24699
neutron scattering by lattice defects in cold-formed and irradiated, 18: 24194 (NP-13930(p.116-17))
neutron scattering by, 18: 24625 (WASH-1046)
performance as coatings on tantalum and tungsten, 18: 23740(R) (NP-13899)
polishing by electrolytic methods, 18: 24107(T) (SC-T-64-903)
radiation effects on stress-strain curves of, strengthening theory on, 18: 24200(T) (ANL-Trans-19)
radiation effects on dislocations in, annealing effects on beta and gamma, 18: 24209
radiation effects on work hardening of single crystals, 18: 24211
radiation effects on crystalline, electron, 18: 24996(R) (NAA-SR-8888(Sect.VI))
reactions with polyacrolein, effects of pH and temperature on precipitate formation in, 18: 23542
separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)
sorption of americium-241 and protactinium-233 by, from water–ethanol solutions, 18: 23724
uses in separation of mercury from radioactive waste solutions by amalgamation, 18: 24977 (ORNL-TM-827)
wetting by molten chlorides and fluorides, sessile drop observations, 18: 23437 (CONF-322-12)

COPPER ALLOYS
polishing by electrolytic methods, 18: 24107(R) (SC-T-64-903)
radiation effects on crystalline, electron, 18: 24996(R) (NAA-SR-8888(Sect.VI))
Ce–Cu–Pu, phase studies, 18: 24815(R) (MLM-1184)
Cr–Cu–Fe–Mo–Ni, performance of Ni–O–Nel 825 in nuclear superheater environment, 18: 24886(R) (GEAP-4565)
Cu–Ni, radioinduced segregation in, rehomogenization kinetics of fast-neutron, 18: 24208
Cu–Pu–U, performance as zero-power reactor fuel, 18: 24952(R) (ANL-6880(p.6-48))
Cu–Sc, crystal structure of, 18: 24157

COPPER CHLORIDES
electric conductivity of melts, temperature coefficients for, 18: 23456(T) (AI-Trans-46)

COPPER ISOTOPES Cu-59
energy levels, 18: 24590 (LADC-6370)

COPPER ISOTOPES Cu-61
energy levels, 18: 24590 (LADC-6370)

COPPER ISOTOPES Cu-63
neutron capture cross sections, 18: 24620(R) (ORNL-TM-874)

COPPER ISOTOPES Cu-64
meson (π^-) reaction, cross sections of particle production in, 18: 24587 (JINR-P-1584)

COPPER ISOTOPES Cu-65
energy levels of, from nickel-65 decay, 18: 24639
neutron capture cross sections, 18: 24620(R) (ORNL-TM-874)

COPPER ISOTOPES Cu-67
gamma spectra, 18: 24585(R) (IDO-16969)

COPPER OXIDES
catalytic effects on radioinduced isomerization of 2-butene, 18: 23667
spectra in low frequency region, infrared, 18: 23549

CORROSION
rates and stationary potentials in fused salts, 18: 24089

CORROSION INHIBITORS
electrochemical process for protection of metals, 18: 24092(P)

CORROSION LOOPS
design and operation for molten lithium hydride, 18: 24085(R) (NASA-CR-54053)
operation of Large Component Test Loop during 1963, 18: 24891(R) (NAA-SR-8888(Sect.I))
operation of Sodium Component Test Installation during 1963, 18: 24891(R) (NAA-SR-8888(Sect.I))

CORTICOSTEROIDS
radiation effects on biosynthesis and biotransformation of, x, 18: 23348

CORTISONE
effects on soluble nuclear proteins in rats, 18: 23192(R) (ANL-6823 (p.124-7))
ulcerigenic effects in rabbits exposed to, 18: 23267

COSMIC ELECTRONS
detection and measurement using lead-plate spark chambers, 18: 23973
detection and measurement by Russian Cosmos satellites, 18: 24327
detection and measurement by Cosmos 3 and 5, 18: 24328

COSMIC MESONS (μ)
energy spectra near sea level, 18: 24339
energy spectra near sea level, 18: 24341
energy spectra, models for, 18: 24340
energy spectrum at sea level, 18: 24336

COSMIC MESONS (π)
energy spectra near sea level, 18: 24341

COSMIC NEUTRINOS
density in space, 18: 24273
reactions with matter, review, 18: 24295

COSMIC PARTICLES

antiproton flux in, 18: 24335
detection and measurement using liquid scintillators in cloud chambers at 3185 m above sea level, 18: 24346
diffusion of, radial magnetic field in, 18: 24330
intensity of, secular variation in stratosphere, 18: 24331

COSMIC PHOTONS
existence at energies near 10^{14} ev with intensity peaked near galactic equator, 18: 24342

COSMIC PROTONS
detection and measurement by Cosmos 3 and 5, 18: 24328
energy spectra near sea level, 18: 24339
energy spectra, models for, 18: 24340

COSMIC RADIATION
absorption in ionosphere, relation of geomagnetic storms to, 18: 24520
bursts in hard component of, analysis of small, 18: 24334
detection and measurement by nuclear emulsions on space probes, 18: 23956
detection and measurement by satellite-borne nuclear emulsions, 18: 23957
detection and measurement of charge and energy spectra of primary, satellite experiment for, 18: 23988
distribution of hard component of, 18: 24337
fluxes and spectra of nuclei in, 18: 24347
intensity of, energy spectra of daily variations of, 18: 24338
intensity of, location of minimum at 14° West longitude, 18: 24329
intensity variations in, effects of changes in electromagnetic states of interplanetary space on, 18: 24345
intensity variations in, observations on, 18: 24347
interactions with neutrinos in universe, theory of, 18: 24348
origin of, 18: 24294
origin of and galactic explosion, 18: 24293

COSMIC SHOWERS
arrival direction of, comparison of cloud chamber and timing array for determination, 18: 24344
arrival directions of, design of millimicrosecond timing apparatus for determining, 18: 23965
burst-size spectrum, 18: 24336
development and size of, at 4,200 m in Bolivia, 18: 24343
existence of gamma rays with energies near 10^{14} ev in, 18: 24342

COSMOLOGY
cosmic ray–neutrino interactions in, theory of, 18: 24348
elementary particle indistinguishability in, 18: 24288
relation of interstellar neutrino density to, 18: 24273
theory of universe in, 18: 24290

COTTON
radioinduced graft polymerization of vinyl monomers on, gamma, 18: 23658(T,R) (AEC-tr-6316(p.650-9))
radiosensitivity of cells, gamma, 18: 23300

COUNTERCURRENT SEPARATION PROCESSES
patent, 18: 23739(P)

COUNTING DEVICES
description of transistorized tunnel-diode low-resolution-time counters, 18: 23864
performance for pulses of 100 MHz and above and with 2 nsec resolution, 18: 24029

CRATERS
formation by chemical and nuclear explosions, depth-of-burst curves for, 18: 23752 (UCRL-7793)
nomenclature system for, 18: 25018 (UCRL-7750)

CREATINE
radiation effects on urinary excretion of, in rats, 18: 23234 (EUR-591.d)

CREEP
measurement of, design of high-temperature optical extensometer for, 18: 25017 (UCRL-7405)

CRITICAL ASSEMBLIES
construction and lattice parameters of plutonium–uranium and uranium fueled, 18: 24865(T,R) (EURAEC-992)
criticality studies in ZPR-III, ELMOE code for, 18: 24813(R) (ANL-6880(p.49-67))
design of CESAR, 18: 24968
fuel development for zero-power, 18: 24952(R) (ANL-6880(p.6-48))
masses of, 18: 24349 (LAMS-3067)
operations and startup of Mixed Spectrum Critical Assembly, 18: 24886(R) (GEAP-4565)
operations of Aquilon, Marius, and Minerve, 18: 24865(T,R) (EURAEC-992)
operations of ZPR-III, -VI, and -IX, summary, 18: 24952(R) (ANL-6880(p.6-48))
reactivity of Mixed Spectrum Critical Assembly, 18: 24884(R) (GEAP-4419)
reactivity studies in High Conversion Critical Experimental Facility, 18: 24813(R) (ANL-6880(p.49-67))
safety analysis of Super Kukla Prompt Burst Reactor, 18: 24964 (UCRL-7695)

CRITICALITY STUDIES
lattice parameters of graphite thermal columns, 18: 24865(T,R) (EURAEC-992)
on P127 nuclear aircraft power plant mockup, 18: 24845 (APEX-638)

CRUSTACEA
feeding rates, 18: 23180 (PG-Report-578)
zinc-65 uptake by, off Oregon coast, 18: 23182

CRYOGENICS
developments in Sherwood Project, 18: 24544(R) (NBS-8253)

CRYSTAL DETECTORS
whole-body counting geometry for, 18: 23394

CRYSTAL STRUCTURE
analysis of, computer calculation of, 18: 24296(R) (AD-417517)
Berg-Barrett x-ray diffraction methods of studying, 18: 25035(T) (UCRL-Trans-1055(L))
defect scattering of conductivity electrons in metals, mechanisms of momentum transfer in, 18: 24167
lattice stability of Abrikosov vortex lines, energy and elastic moduli calculations of, 18: 24230
neutron scattering studies of defect arrangement in, 18: 24194 (NP-13930(p.116-17))

CRYSTALLOGRAPHY
determination of orientation of crystals and foils, 18: 24994(R) (MND-2531-1)

CRYSTALS
freezing point depression of, effects of crystal habit and size on, 18: 25028(T) (ORNL-tr-72)
grain-boundary mobility effects in rare gas-containing, 18: 23566
orientation of, crystallographic determination of, 18: 24994(R) (MND-2531-1)
phase transformations in, analysis of martensitic, 18: 24994(R) (MND-2531-1)

CURIUM ISOTOPES Cm-242
yields in heavy ion reactions with thorium and uranium-22, 18: 24689

CYCLOHEXANE
cyclohexane–phenylcyclohexane, radioinduced gas production in, 18: 23656(T,R) (AEC-tr-6316(p.623-39))
deuterium exchange in, with catalyst of rare earth oxides, 18: 23573
radioinduced oxidation of, effects of temperature and heat treatment on, 18: 23655(T,R) (AEC-tr-6316(p.616-22))

CYCLOHEXANE, PHENYL-
cyclohexane–phenylcyclohexane, radioinduced gas production in, 18: 23656(T,R) (AEC-tr-6316(p.623-39))
radioinduced oxidation of, gamma, 18: 23656(T,R) (AEC-tr-6316(p.623-39))

1,4-CYCLOHEXANEDIOL
radioinduced free radicals in, electron spin resonance studies of, 18: 23649(T,R) (AEC-tr-6316(p.538-50))

CYCLOHEXANOL
dehydration of, effects of protactinium-231 alpha particles on catalytic activity of magnesium sulfate in, 18: 23672
yields in radioinduced oxidation of cyclohexane, 18: 23655(T,R) (AEC-tr-6316(p.616-22))

CYCLOHEXANONE
yields in radioinduced oxidation of cyclohexane, 18: 23655(T,R) (AEC-tr-6316(p.616-22))

CYCLOPENTADIENE
radioinduced polymerization, gamma, 18: 23597(T,R) (AEC-tr-6316(p.19-62))

CYCLOTRONS
alpha-particle acceleration in Russian U-120, 18: 24260

analytical use in electron bombardment reactions, 18: 24319
charged-particle orbits in isochronous ultrarelativistic, stability of equilibrium, 18: 24258
charged-particle orbits in isochronous ultrarelativistic, stability of equilibrium, 18: 24259
construction of sector-focused, summary, 18: 24239(R) (AFOSR-J1340)
data processing for, computer-analyzer system for real-time reduction of multiparameter data, 18: 23860
facilities for medical and physics research, 18: 24249 (UCRL-11316)
particle motion in, equations for, 18: 24257

CYLINDERS
heat transfer to fluids flowing through annuli between, 18: 23766(R) (GEAP-4431)
impact shock of cylindrical projectiles on ground, 18: 25001(R) (SC-DC-64-459)
particle collision probabilities in, computer program for calculating, 18: 24377 (AEEW-M-442)

CYSTEINE
synthesis and transformation in uv photolysis of organic compounds in mixtures with ammonium compounds, 18: 23204(T) (JPRS-24164 (p.19-42))

CYSTINE
synthesis and transformation in uv photolysis of organic compounds in mixtures with ammonium compounds, 18: 23204(T) (JPRS-24164(p.19-42))

CYTIDINE, 2′-DEOXY-
radiation effects on urinary excretion of, 18: 23382

CYTOCHROME C
effects on carbon oxide radiation prophylactic properties, 18: 23383

CYTOLOGY
of hamster cells in culture, 18: 25008 (TID-19032)
of Paramecium mitosis, 18: 23163(R) (ANL-6823(p.178-88))
of primary immune response in spleen of mice, 18: 24998 (ORNL-3595)
radiation effects on bean seed, gamma, 18: 23252(T) (ORNL-tr-84)
radiation effects on *Aedes aegypti*, x, 18: 23262
radiation effects on microstructure of duodenum cells in rats, 18: 23266

CYTOPLASM
radiation effects on movement of, gamma and x, 18: 23274

D

DAPHNETIN, 3-PHENYL-
analytical use for hexavalent uranium determination, 18: 23429

DATA RECORDING SYSTEMS
description of four-channel digital commutator for single output, 18: 23855
description of, for particle track analysis in emulsion, 18: 23941
design for analysis of particle tracks in nuclear emulsion, 18: 23939
for personnel radiation doses, semi-automatic, 18: 23818 (AWRE-O-93/63)
laboratory measuring and registering center for multiparameter analyses in nuclear physics, 18: 23861
use of intermediate memory in analyzers under pulse conditions, 18: 24011

DATA TABULATIONS
book: *High-Temperature Materials.* No. 1, *Materials Index*, 18: 24075
critical masses, 18: 24349 (LAMS-3067)
emissivity of spacecraft-radiator materials, 18: 24139(R) (PWA-2206 (Vol.II))
gamma spectra of neutron-deficient isotopes, 18: 24585(R) (IDO-16969)
on radiation levels within and behind beryllium oxide, 18: 24806 (XDC-61-1-149)
plutonium-241 fission cross sections at 2 to 100 ev, 18: 24586 (IDO-16976)
solar flare parameters, 18: 24269 (NP-12801)
x-ray-fluorescence spectra of topaz crystal, 18: 24216 (Y-1470-B)

DECONTAMINATING SOLUTIONS
development, 18: 23835(P)

DECONTAMINATION OF EQUIPMENT
methods for, 18: 23835(P)
methods for, for uranium–zirconium processing plants, 18: 23705 (ORNL-TM-837)

DECYLAMINE
tri-, reactions with hydrochloric acid, hydrogen bond formation in, 18: 23577

DEHYDROGENASES
radioinduced lymphoid leukemia effects on activity of lactic, in mice, 18: 23256

DENSITOMETERS
design of radiometric, 18: 24048(P)

DEUTERIUM
crystal structure, 18: 24558
dissociation and ionization, analysis of, 18: 24797
effects on racemization of 9,10-dihydro-4,5-dimethylphenanthrene, 18: 23574
enrichment in hydrogen reactions with amides, 18: 24058(P)
exchange between heavy and light water and silk fibroin, 18: 23470
exchange of, in cyclohexane with catalysts of rare earth oxides, 18: 23573
proton reactions (p,2p) with, 18: 24625 (WASH-1046)
radioinduced reactions with Teflon, electron spin resonance studies of, 18: 23648(T,R) (AEC-tr-6316(p.534-7))
reactions with gases at 20 Mev, electron detachment in, 18: 24310
triton reactions (t,n) with, efficiency as neutron source, 18: 24579

DEUTERIUM IONS
production of polarized negative, 18: 24680
reactions with nuclear emulsions, effects of energy and mass on grain darkening in, 18: 23916

DEUTERIUM SYSTEMS
D–O, oxygen vibrational de-excitation in, 18: 24315

DEUTERONS
acceleration in CERN linear accelerator, 18: 24241 (CERN-64-22)
angular distributions from helium-3 reactions with nickel-58 and -60, 18: 24590 (LADC-6370)
detection and discrimination of low-energy, in emulsions, 18: 23943
detection and measurement using semiconductor counter telescope, 18: 23985
emission in lithium reactions with boron-10 and -11 at 3.5 to 4.5 Mev, angular distributions for, 18: 24720
emission in lithium-6 reactions with light nuclei at 36 and 63 Mev, spectra of, 18: 24723
form factors of, electromagnetic, 18: 24439
interactions with neutrons of 2.8 to 3.6 Mev, dineutron threshold effects in, 18: 24444
interactions with protons at 210 Mev, polarization corrections in quasi-free, 18: 24450
interactions with mesons (π^-), energy and angular distributions from, 18: 24451
interactions with mesons (K^+) in $I = 0$ state at low energies, 18: 24457
interactions with mesons (π^-), neutron-neutron scattering length in, 18: 24462
interactions with mesons (π^+), meson (f^0) production in, 18: 24463
interactions with meson (π), poles of generation amplitudes for, 18: 24470
interactions with protons, meson (π) production in, 18: 24474
interactions with neutrons, proton spectrum from, 18: 24398 (NP-13961)
kinetic behavior in heavy ice, 18: 23466
photodisintegration at 11 to 130 Mev, cross sections and polarization for, 18: 24416
photoproduction on tritons, analysis of, 18: 24705
production in proton-bombardment cascade in nuclei, perturbation theory for, 18: 24664
reactions (d,n) with tritium, efficiency as neutron source, 18: 24579
reactions (d,n) with beryllium-9, boron-10, boron-11, phosphorus-31, and silicon-28, 18: 24611 (NP-13930(p.132-3))
reactions (d,p) with calcium-40 at 11 Mev, finite-range effects in distorted-wave theory of, 18: 24667
reactions (d,p) with nuclei at 8 and 10.1 Mev, finite range effects in, 18: 24686
reactions (d,p) with nuclei at 21 Mev, interference effects in, 18: 24713
reactions (d,p) with nuclei at 11.8 Mev, angular distributions for, 18: 24648
reactions (d,^{3}He) with calcium-40 and stable titanium isotopes, angular distributions and cross sections for, 18: 24672
reactions with gases at 20 Mev, electron detachment in, 18: 24310

reactions with nuclei, inelastic effects in stripping, 18: 24652
reactions with nuclei, stripping, 18: 24400 (NYO-1807-9)
reactions with tritium, polarization in, 18: 24680
scattering by carbon-12 at 70 Mev in sonic spark chambers, data processing for, 18: 24000
scattering by helium-4 at 4 to 7.5 Mev, tensor polarization in, 18: 24647

DIDO REACTORS
contamination control of environs of, 18: 23811 (AERE-R-4528 (p.25-33))
radiation beams from, accidental exposure to, 18: 23813 (AERE-R-4528(p.49-53))
storage of spent fuel elements from, 18: 23814 (AERE-R-4528(p.55-67))
tritium control in water-d_2 in, 18: 23812 (AERE-R-4528(p.35-47))

DIET
calcium-45 in mouse, tumorigenic effects of, 18: 23231(R) (ANL-6823(p.20-43))
effects of calcium-rich, on strontium-90 content in rats, 18: 23216
effects of semisynthetic, on growth and weight in dogs, 18: 23184(R) (ANL-6823(p.44-75))
strontium-90 in mouse, tumorigenic effects of, 18: 23231(R) (ANL-6823(p.20-43))

DIETHYLAMINE
dissociation by electron bombardment, mass spectra from, 18: 23608(T,R) (AEC-tr-6316(p.232-7))

DIFFERENTIAL EQUATIONS
solution by expansion in matrix series, FORTRAN program for first-degree coupled equations, 18: 24061 (TDSI-49)
solution over two-dimensional region, zoning method for finite-difference, 18: 25014 (UCRL-7312)

DIFFUSION
measurement of volume, by autoradiography, 18: 23522
of gases in variable-intensity media, 18: 24333

DIMETHYLAMINE
dissociation by electron bombardment, mass spectra from, 18: 23608(T,R) (AEC-tr-6316(p.232-7))

DINEUTRONS
effects on neutron-deuteron scattering cross sections, 18: 24444

DIODES
development of nuclear-thermionic, summary, 18: 24857(R) (GEST-2031)
electric current lifetimes in semiconductor, measurement of, 18: 23756
electron tunneling in, 18: 24548
ionization in nuclear plasma, 18: 24373
metallurgical examination of thermionic, after failure, 18: 24368 (JPL-TR-32-548)
performance of tunnel, in discriminator circuits for semiconductor detectors, 18: 24031
use of tunnel, in high-speed monostable multivibrator circuits, 18: 23863

DIPROPYLAMINE
dissociation by electron bombardment, mass spectra from, 18: 23608(T,R) (AEC-tr-6316(p.232-7))

DIRECT ENERGY CONVERSION DEVICES
conference on, 18: 24352 (ANL-6802)
evaluation of, characteristics for, 18: 24363 (ANL-6802(p.163-5))
status of fission-electric, 18: 24371 (RM-3908-PR)

DISASTERS
environmental hazards from fission product release during, 18: 23816 (AHSB(S) R-64)

DISEASES
degenerative, role of excesses of trace elements in, in man, 18: 23199 (BNL-828)
radiation effects on serum-resistant syphilis, 18: 23391

DISKS
radiation field diffraction on, 18: 24516(T) (JPRS-24633)

DISTILLATION APPARATUS
design of vacuum, for concentrating heat-labile solutions, 18: 23445 (K-1594)

DISULFIDES
diphenyl-, effects on radioinduced isomerization of 2-butene, 18: 23666

DOGS
bremsstrahlung efficiency of strontium-90 plus yttrium-90 in bones of, 18: 23173
effects of radiation sickness on regeneration of nerves after traumatic injury in, 18: 23250(T) (JPRS-24704(p.12-17))
radiation effects in, lethal, 18: 23245 (UR-654)
radiation effects on bone marrow blood formation in, chronic-exposure, 18: 23305
radiation effects on albumin and globulin in, 18: 23306
radiation effects on nerve structure in liver of, 18: 23309
radiation effects on reproduction in beagle, as affected by aging, x, 18: 23341
radiation effects on reproduction in, x, 18: 23345
radiation effects on neuro-endocrine system, 18: 23377
radiation effects on, effects of procaine on, 18: 23384
radiation sickness effects on central nervous system of, 18: 23310
radionuclide metabolism and toxicity in beagle, 18: 23184(R) (ANL-6823(p.44-75))

DROSOPHILA
radiation effects on female germ cells of, x, 18: 23281
radioinduced translocations in, linear dose dependence of, 18: 23282
temperature effects on irradiated sperm brood pattern, 18: 23279

DRUGS
effects on enzyme activity in liver of irradiated rats, 18: 23241(R) (NP-13918(p.13-27))

DYES
use of solochrome azurine for determination of thorium, 18: 23424

DYSPROSIUM
high-temperature allotropy of, 18: 24176
magnetic properties of, effects of crystalline field and structure on, 18: 24186
polarographic behavior in tetraethylammonium bromide at dropping mercury electrode, 18: 23463
proton elastic scattering at 55 Mev, effects of nuclear deformation on, 18: 24665

DYSPROSIUM ALLOYS
Dy–Mg, high-temperature allotropy and phase studies on, 18: 24176

DYSPROSIUM CARBIDES
electric conductivity and thermoelectric power at room temperature to 4°K, 18: 23511

DYSPROSIUM COMPLEXES
with 2,2′-dipyridyl, preparation and fluorescence and infrared spectra of, 18: 23500

DYSPROSIUM ETHYL SULFATES
spin-lattice relaxation in, 18: 23528

DYSPROSIUM IONS
electron paramagnetic resonance in calcium fluorides, spin-lattice relaxation in, 18: 23527
electron spin resonance in calcium fluorides, spectra of, 18: 23524

DYSPROSIUM ISOTOPES Dy-149
charge distribution of, from heavy ion reactions with rare earths, 18: 24624 (UCRL-10806)
recoil in carbon reactions (C-12,7n) with neodymium-144 at 108 Mev, ranges of, 18: 24734

DYSPROSIUM ISOTOPES Dy-160
oxygen-16 scattering at 38 to 48 Mev, level excitation in, 18: 24729

DYSPROSIUM ISOTOPES Dy-162
oxygen-16 scattering at 38 to 48 Mev, level excitation in, 18: 24729

DYSPROSIUM ISOTOPES Dy-164
oxygen-16 scattering at 38 to 48 Mev, level excitation in, 18: 24729

DYSPROSIUM OXALATES
dynamic decomposition of, effects of air, carbon dioxide, and nitrogen on, 18: 23507

DYSPROSIUM OXIDES
magnetic susceptibility at 4.2 to 300°K, 18: 23513
spectra in low frequency region, infrared, 18: 23549
CeO_2–Dy_2O_3, equilibrium phase studies on, 18: 23509
Dy_2O_3–ZrO_2, crystal structure, differential thermal analysis, and thermal expansion of, 18: 23503

DYSPROSIUM PHOSPHATES
magnetic susceptibility at 20 to 900°K, 18: 23512

E

EARTH
- crustal material of, rubidium and strontium content in, 18: 23801
- rotational speed of, relation to solar activity, 18: 24528

EARTHQUAKES
- relation to solar activity, 18: 24528
- seismic energy from, studies of high-frequency, 18: 23784 (NP-13956)

ECOLOGY
- disasters, historical examples applicable to nuclear warfare, 18: 23179 (HI-303-RR/A1-2)
- effects of nuclear warfare on, input-output analysis of, 18: 23178 (HI-303-RR/A-III)
- effects of thermonuclear warfare on, 18: 23822 (HI-303-RR/A-IV)
- of lizard population at Nevada Proving Ground after Sedan underground explosion, 18: 23181 (UCLA-12-522)
- of marine ecosystems, 18: 23167(R) (STI/DOC/10/25(p.71-98))

ELECTRIC ARCS
- noise removal in, use of resonators in fast-wave, 18: 23848

ELECTRIC CONDENSERS
- radiation effects on, neutron, 18: 24822 (PWAC-427)

ELECTRIC CONDUCTIVITY
- ion entrainment by electrons in metals, 18: 24167
- measurement using d-c induction method, 18: 23837 (CEA-R-2402)

ELECTRIC CONTROL SYSTEMS
- theory, 18: 24516(T) (JPRS-24633)

ELECTRIC DISCHARGE
- magnetic skin effect in h-f ring, 18: 24800
- mechanism of high-frequency plasmoid, 18: 24774
- stability in, pressure dependence of, 18: 24784

ELECTRIC FIELDS
- charged particle focusing in crossed magnetic and, 18: 24262
- charged particle motion in, equations for, 18: 24509
- effects of high-frequency, on glow discharges, 18: 24796
- interactions with plasma, review on, 18: 24746 (ARL-64-34)

ELECTRIC GENERATORS
- development of fission-electric, 18: 24372(R) (TID-20575)
- development of nuclear-thermionic, summary, 18: 24857(R) (GEST-2031)
- development of thermoelectric, for space uses, 18: 24351(R) (AD-427285)
- development of thermionic, summary, 18: 24369(R) (NP-13892)
- development of thermionic, for space uses, 18: 24370(R) (PWA-2337)
- development of thermionic, summary, 18: 24350(R) (AD-418276)
- performance of explosive-MHD-cell, 18: 24365(R) (ASD-TDR-63-37)
- power conditioning, distribution, and generation systems in, 18: 24942

ELECTRIC INSULATORS
- radiation effects on, gamma and neutron, 18: 24937 (APEX-917)

ELECTRIC POWER
- production of, evaluation of devices for, 18: 24363 (ANL-6802(p.163-5))

ELECTRIC PROBES
- use in plasma diagnostics, 18: 24782
- use of guard ring shields on negatively biased Langmuir ion-collection, 18: 24756 (NP-13946)

ELECTRODES
- design for extended-surface thermionic cells, 18: 24361 (ANL-6802 (p.144-51))

ELECTRODYNAMICS
- Lorentz invariance of S-matrix in, gauge invariance and equivalence from, 18: 24501

ELECTROLYSIS
- use for oxidation of cerium for separation from other rare earths, 18: 23727

ELECTROLYTIC POLISHING
- mechanisms and uses of, 18: 24107(T) (SC-T-64-903)

ELECTROMAGNETIC FIELDS
- gravitational fields from, structure of, 18: 24487
- of charged particles in moving dispersive media, 18: 24484(T) (JPRS-24633(p.275-80))

ELECTROMAGNETIC PUMPS
- development of helical-rotor, for sodium-cooled power reactors, 18: 24891(R) (NAA-SR-8888(Sect.I))

ELECTROMAGNETIC WAVES
- dispersion by oblique conducting helix, 18: 24516(T) (JPRS-24633)
- electron acceleration by, in magnetic fields, 18: 24252(T) (JPRS-24633 (p.26-42))
- emission by electrons in magnetic field, kinetic equations for, 18: 24765(T) (JPRS-24633(p.43-61))
- frequency of, in scattering by moving bodies in media, 18: 24741 (AFOSR-5367)
- interactions with plasma, bibliography on, 18: 24748 (CLM-Bib-4)
- propagation in laminated media, 18: 24808
- propagation in multicomponent plasma, effect of ion concentration on, 18: 24778
- propagation of, acausality and dispersion relations in, 18: 24383 (JINR-E-1646)
- propagation through isotropic medium, nonlinear theory for, 18: 24215 (RM-4093-PR)
- reactions with atomic many-body systems, dynamics of, 18: 24309
- reactions with plasma, diagnostics in, 18: 24744 (ANL-6802(p.113-19))
- scattering by plasma, spectral density relation for, 18: 24752 (MATT-217)
- transformation of, on plasma boundary in magnetic field, 18: 24766(T) (JPRS-24633(p.62-77))
- velocity in drifting plasma, 18: 24777

ELECTRON BEAMS
- efficiency drift at 15 Mev, use of linear accelerator for study of, 18: 24253
- interactions with coupled resonators, equations for, 18: 24516(T) (JPRS-24633)
- properties in perturbed axially symmetric magnetic field, 18: 24256
- reactions with metals, plasma production from melting in, 18: 24798
- use in furnaces, 18: 23758(P)
- use of synchrotron internal, for (e,e'p) reaction studies, 18: 24243 (ISS-63/42)

ELECTRON MICROSCOPY
- nuclear emulsion preparations for use in, 18: 23845
- of amoebae, fixatives for, 18: 23162(R) (ANL-6823(p.174-7))
- of hamster cells in culture, 18: 25008 (TID-19032)
- precision trimmer for specimen sectioning for, design of, 18: 23164(R) (ANL-6823(p.189-90))
- uses for crystallographic analysis of foils, 18: 24994(R) (MND-2531-1)

ELECTRON TUBES
- radiation effects on ceramic, neutron, 18: 24822 (PWAC-427)

ELECTRONIC EQUIPMENT
- design for analysis of particle tracks in nuclear emulsion, 18: 23939
- design of pre-scaler with 10 nsec resolving time, 18: 24030
- development, 18: 24625 (WASH-1046)

ELECTRONICS
- applications of fast circuitry in nuclear physics, 18: 24014
- conference on nuclear, Paris, Nov. 1963, 18: 23970

ELECTRONS
- acceleration by electromagnetic waves in magnetic field, 18: 24252(T) (JPRS-24633(p.26-42))
- acceleration in earth's radiation belts, 18: 24332
- back scattering by soybean oil—saran film systems, 18: 23688
- backscattering from aluminum, iron, and lead at 4 to 14 Mev, 18: 24409
- bombardment of uranium by, at 8 to 13 Mev, delayed neutron yields in, 18: 24574
- containment by magnetic fields, in plasma duplexer, 18: 24740(R) (AD-426769)
- densities in auroral zones, 18: 24532
- densities in hydrogen plasma, 18: 24745 (ANL-6802(p.120-5))
- detachment in deuterium and deuteron reactions in gases at 20 Mev, cross sections for, 18: 24310
- detection in nuclear emulsion and measurement, 18: 23924
- detection of 0.1- to 5-Bev/c, in nuclear emulsions, 18: 23953
- detection of, multichannel detector for, 18: 23895
- dissociation of aliphatic amines by, mass spectra from, 18: 23608(T,R) (AEC-tr-6316(p.232-7))
- distributions in Van Allen Belts, effects of vlf electromagnetic oscillations on, 18: 24519
- effects on branching in polyisobutene, effects of temperature on,

18: 23682
effects on clays and soils, 18: 23171
effects on crystalline solids, 18: 24996(R) (NAA-SR-8888(Sect.VI))
effects on electric conductivity of glass, polyethylene, and poly(methyl methacrylate), 18: 24203
effects on mass and optical spectra of air-like mixtures, 18: 24300(R) (NP-13953)
effects on rat seminiferous tubules, 18: 23332
energy dissipation in aluminum at 1.0, 1.5, and 1.8 Mev, distribution of, 18: 24626(T,R) (AEC-tr-6316(p.35-41))
energy dissipation in beryllium at 1.0 to 1.6 Mev, distribution of, 18: 24627(T,R) (AEC-tr-6316(p.42-5))
energy straggling in absorbing layers, 18: 24297 (AFCRL-63-558)
interactions and spins in transition metals, 18: 24305
interactions with plasma bunches in synchrotrons, 18: 24265
interactions with relativistic charged particles in nuclear emulsion, 18: 23908
interactions with phonons in metals and superconductors, 18: 24557
interactions with electrons in atoms, inelastic, 18: 24307
interactions with positrons, W-boson production in, 18: 24397 (NP-13954)
ionization by secondary, in nuclear plasma diodes, 18: 24373
kinetic equations for plasma, in magnetic field, 18: 24765(T) (JPRS-24633(p.43-61))
motion of Bloch, in magnetic fields, 18: 24504
motion of Bloch, in magnetic fields, 18: 24505
oscillations in synchrotrons, electrodynamic, 18: 24264
penetration through aluminum foils at 1 to 12 kev, energy distribution from, 18: 24317
photoemission by interplanetary dust, 18: 24279
polarization of, deformation cooling for, 18: 24703
radio noise from auroral, 18: 24537
reactions (e,e'p) with nuclei, proposed use of synchrotron internal beam to study, 18: 24243 (ISS-63/42)
reactions in bromo- and chlorobenzene, capture and dissociation processes in, 18: 23686
reactions in polystyrene at 20 to 86 Mev, ionization energy losses in, 18: 24702
reactions of hydrated, in radiolysis of liquids, 18: 23691
reactions with atoms, theory of ionization in, 18: 24308
reactions with deposited films, products from, 18: 24319
reactions with ferrous sulfate, induced oxidation in pulsed, 18: 23692
reactions with hydrogen atoms, energy level transitions in, 18: 24314
reactions with ions in metals, theory of, 18: 24170
reactions with ion beams in magnetic fields, neutralization in, 18: 24301(T) (FTD-TT-64-176)
reactions with liquids, hydrated electron absorption spectrum and reactions in decomposition, 18: 23691
reactions with neon at 25 to 150 ev, photon emission in, 18: 24700
reactions with paramagnetic ions in superconductors, theory of, 18: 24555
reactions with photographic emulsions, latent image formation in, 18: 23907
reactions with plasma ions, bremsstrahlung emission from, 18: 24792
reactions with plasma ions, energy balance and recombination in, 18: 24793
reactions with plasma ions, energy balance and recombination in, 18: 24794
reactions with plasma ions, recombination coefficient for, 18: 24801
relative biological effectiveness of high-energy, 18: 23314
scattering by air, electron loss frequencies for, 18: 24300(R) (NP-13953)
scattering by alkali atoms at low energies, cross sections for elastic, 18: 24298 (N64-13373)
scattering by atoms at low energies, cross sections for, 18: 24302
scattering by carbon-12 and oxygen-16 at 40 to 70 Mev, excitation of E1 giant resonance in inelastic, 18: 24671
scattering by carbon, lithium-6, magnesium, and silicon at 40 to 70 Mev, form factors for strong M1 transitions following inelastic, 18: 24675
scattering by carbon-12 and lithium-6 at 40 to 70 Mev, form factors for M1 transitions following inelastic, 18: 24676
scattering by coulomb fields, double bremsstrahlung production in, 18: 24704
scattering by impurity centers in metals, 18: 24167
scattering by nuclei, partial-wave analysis of inelastic, 18: 24669
scattering by thin films at 1 to 15 kev, angular distribution for, 18: 24304
spectra from neon atom and ion bombardment of molybdenum, 18: 24318
superconducting behavior in spin-exchange fields, 18: 24563
temperature of solar-corona, 18: 24278
temperatures in helium plasma, 18: 24744 (ANL-6802(p.113-19))
trapping of 1.8-kev, in magnetic mirror bottles using electrostatic periodic perturbations, 18: 24747 (CEA-R-2417)
wave functions, 18: 24426

ELECTROPHORESIS
use in separation of alkali metals, tracer studies of, 18: 23729
uses in separation of alkali metals in potassium ferrocyanide solutions, 18: 23730

ELECTROSTATIC FIELDS
shielding properties, 18: 24807

ELECTROSTATIC PRECIPITATORS
use for collection of artificial radioactive dust particles, 18: 23796

ELEMENTARY PARTICLES
book: *Elementary Particles*, Chicago Lectures in Physics, 18: 24482
book: *The Development of Weak Interaction Theory*, a collection of reprints, 18: 24514
field theory for spin ½, transformations in, 18: 24493
field theory for, transformations in, 18: 24494
field theory for, bound states versus elementary particles in Zachariasen model with $Z_3 = 0$, 18: 24458
interactions and approximations, 18: 24400 (NYO-1807-9)
interactions at high energies, many-body production in elastic, 18: 2447
interactions in three-body systems of, compound particle excitation in, 18: 24385 (JINR-P-1593)
interactions of three-body systems of, analytic continuation of amplitudes in, 18: 24440
interactions of unstable, resonance poles in amplitudes for, 18: 24433
interactions of, bibliography on, 18: 24214 (AED-C-23-01)
interactions of, conservation laws and symmetry in, 18: 24508
interactions of, cross sections for strong and electromagnetic, 18: 24382 (JINR-E-1623)
internal symmetries, review on, 18: 24379 (CONF-510-1)
lifetimes and masses of unstable, 18: 24420
many-body system of, graphical representation of S-operators of quantum-mechanical, 18: 24486
mass of gauge, in quantum field theory, 18: 24437
position operators for spinning, relativistically invariant, 18: 24401 (NYO-10270)
properties in cosmology, indistinguishability of, 18: 24288
Regge trajectories, analytical properties of, 18: 24421
spin state separation of, with maximum spin 2, conformal, 18: 24410
theory using self-coupled scalar field ground states, 18: 24485

ELEMENTS
determination of traces of, neutron-activation, 18: 23428

ELK RIVER POWER REACTOR
fuel loading analysis for, second-core, 18: 24875 (ACNP-64536)

EMBRYOS
pathological effects of injected strontium-90 in rat, 18: 23244 (UR-643)
radiation effects on chick, gamma, 18: 23229(R) (ANL-6823(p.5-14))

EMISSIVITY
analysis of, in radiator materials for space uses, 18: 24138(R) (PWA-2206(Vol.I))
analysis of, in radiator materials for space uses, 18: 24139(R) (PWA-2206(Vol.II))
analysis of, in radiator materials for space uses, 18: 24140(R) (PWA-2206(Vol.III))

ENDOCRINE GLANDS
radiation effects on dogs and rabbits, 18: 23377

ENZYMES
effects of uranyl nitrate on 1,6-diphosphoaldolase fructose activity in mouse kidney, 18: 23213
occurrence and properties of lipoxidase and lipodehydrase in seeds and plants, 18: 25023(T) (ANL-Trans-21)
purification of Saccharomyces homocepteine methyltransferase, 18: 23193(R) (ANL-6823(p.128-40))
radiation effects on activity of, in rat liver, 18: 23241(R) (NP-13918(p.13-27))

radiation effects on activity of myosin ATPase, x, 18: 23258
radiosensitivity of, effects of steroids on, in rat liver, 18: 23352(R) (NP-13918(p.28-41))

EPITHELIUM
radiation effects on cornea, proton, 18: 23303

EQUIPMENT AND PROCEDURES
description of, for detection of underground formations, 18: 23781 (NP-13943)
fluid longitudinal dispersion in process equipment, 18: 23755 (UCRL-11157)

ERBIUM
high-temperature allotropy of, 18: 24176
magnetic properties of, effects of crystalline field and structure on, 18: 24186
polarographic behavior in tetraethylammonium bromide at dropping mercury electrode, 18: 23463

ERBIUM ALLOYS
Er–Mg, high-temperature allotropy and phase studies on, 18: 24176

ERBIUM CARBIDES
electric conductivity and thermoelectric power at room temperature to 4°K, 18: 23511

ERBIUM COMPLEXES
with EDTA, stereochemistry of, 18: 23518
with 2,2′-dipyridyl, preparation and fluorescence and infrared spectra of, 18: 23500

ERBIUM COMPOUNDS
spectra of, evidence of covalent binding in, 18: 23438 (CONF-405-35)

ERBIUM IONS
covalency of, spectral evidence of, 18: 23438 (CONF-405-35)
electron paramagnetic resonance in calcium fluorides, relaxation in, 18: 23526
electron paramagnetic resonance in calcium fluorides, spin-lattice relaxation in, 18: 23527

ERBIUM ISOTOPES Er-164
oxygen-16 scattering at 38 to 48 Mev, level excitation in, 18: 24729

ERBIUM ISOTOPES Er-166
oxygen-16 scattering at 38 to 48 Mev, level excitation in, 18: 24729

ERBIUM ISOTOPES Er-168
oxygen-16 scattering at 38 to 48 Mev, level excitation in, 18: 24729

ERBIUM ISOTOPES Er-170
oxygen-16 scattering at 38 to 48 Mev, level excitation in, 18: 24729

ERBIUM MANGANATES
magnetic properties and manganese ion moment configurations of, 18: 24128 (CONF-405-34)
magnetic structures, 18: 23523

ERBIUM OXALATES
dynamic decomposition of, effects of air, carbon dioxide, and nitrogen on, 18: 23507

ERBIUM OXIDES
magnetic susceptibility at 4.2 to 300°K, 18: 23513
spectra in low frequency region, infrared, 18: 23549

ERBIUM SYSTEMS
Er–Se, crystal chemistry and phase studies of, 18: 23506
Er–Te, crystal chemistry and phase studies of, 18: 23506

ERYTHRITOL
radioinduced free radicals in, electron spin resonance studies of, 18: 23649(T,R) (AEC-tr-6316(p.538-50))

ERYTHROCYTES
analysis for calcium and magnesium, activation, 18: 23418
radiosensitivity of, effects of acrylamide and vinyl pyrrolidone on, 18: 23381
reduction of catalase levels in mouse, 18: 23186(R) (ANL-6823(p.86-90))

ESCULIN
protective effects against radiation injuries to rabbit skin, 18: 23372

ESTROGENS
effects on rat seminiferous tubules, 18: 23332
radiation effects on urinary, 18: 23346

ETHANE
radioinduced reactions with Teflon, electron spin resonance studies of, 18: 23648(T,R) (AEC-tr-6316(p.534-7))

ETHANE, BROMO-
effects on radioinduced isomerization of 2-butene, 18: 23666

ETHANE, CHLOROTRIFLUOROIODO-
preparation of, formation of isomers in, 18: 25016 (UCRL-7373)

ETHANE, DIBROMO-
effects on gamma-induced cis-trans transformation of natural rubber, 18: 23636(T,R) (AEC-tr-6316(p.444-8))

ETHANE, IODO-
electric conductivity of aluminum, gallium, and indium iodides in, 18: 23449 (PAN-491/V)

ETHANETHIOL, 2-AMINO-
effects on cholesterol content of adrenal glands in rats during radiation sickness, 18: 23322
protective effects of, against radiation injuries in rats, synergistic effects of 2-imino-thiazolidine-4-carboxylic acid, 18: 23353(R) (NP-13918(p.42-57))
radiation effects on metabolism in liver and spleen of rats, 18: 23304
radiosensitivity effects on neuro-endocrine system of dogs and rabbits, 18: 23377
toxic effects in rats, effects of sodium pentobarbital, hexamethonium bromide, and ergotamine tartrate on, 18: 23202(R) (NP-13918(p.1-12))
toxic effects of, in diet of normal and irradiated mice, 18: 23358(R) (NP-13918(p.116-28))

ETHANETHIOLS, 2-AMINO-
radiosensitivity effects on bean seedling roots, 18: 23379

ETHANOL
effects on radioinduced graft polymerization of styrene on polyvinyl alcohol, 18: 23581(T,R) (AEC-tr-6316(p.66-9))
sorption of americium-241 and protactinium-233 from aqueous solutions of, 18: 23724

ETHANOL, 2-AMINO-
effects on isotope exchange between carbon dioxide as gas and as solute in, 18: 24052(T) (ORNL-tr-68)

ETHANOL, 2,2′,2″-NITRILOTRI-
reactions in nuclear emulsion, 18: 23550
reactions with silver bromides in emulsions, 18: 23552

ETHER, ETHYLVINYL
radioinduced polymerization of, gamma, 18: 23592(T,R) (AEC-tr-6316 (p.131-3))

ETHER, ISOBUTYL VINYL
radioinduced polymerization of, gamma, 18: 23592(T,R) (AEC-tr-6316 (p.131-3))

ETHERS
solvent properties for cerium, 18: 23727

ETHYL SULFATES
genetic effects of, in wheat, 18: 23320

ETHYLAMINE
dissociation by electron bombardment, mass spectra from, 18: 23608(T,R) (AEC-tr-6316(p.232-7))

ETHYLAMINE, 2,2′-DITHIOBIS-
radiosensitivity effects on bean seedling roots, 18: 23379

ETHYLENE
effects on radioinduced polymerization of propionitrile, 18: 23627(T,R) (AEC-tr-6316(p.432-4))
effects on radioinduced polymerization of acrylonitrile, 18: 23630(T,R) (AEC-tr-6316(p.437-8))
effects on radioinduced polymerization of dimethylformamide, 18: 23631(T,R) (AEC-tr-6316(p.439))
radioinduced polymerization with tetrafluoroethylene, 18: 23626(T,R) (AEC-tr-6316(p.431))
radioinduced polymerization at low temperatures, mechanism of, 18: 23635(T,R) (AEC-tr-6316(p.443))
radioinduced reactions with acetaldehyde, gamma, 18: 23611(T,R) (AEC-tr-6316(p.253-60))
radioinduced reactions with 2-propanol, gamma, 18: 23612(T,R) (AEC-tr-6316(p.261-5))

ETHYLENE, CHLORO- POLYMERS
gamma dose absorption by, boundary effect in, 18: 24217(T,R) (AEC-tr-6316(p.9-16))
radioinduced coloration of films of, use for beta dosimetry, 18: 23894(T,R) (AEC-tr-6316(p.46-48))
radioinduced coloring of, mechanism of, 18: 23625(T,R) (AEC-tr-6316 (p.381-94))
radioinduced free radicals in, singlets in electron spin resonance spectra

produced at high doses, 18: 23616(T,R) (AEC-tr-6316(p.306-9))
radioinduced free radicals in, concentration of, 18: 23618(T,R) (AEC-tr-6316(p.314-21))
radioinduced free radicals in, oxidation of, 18: 23619(T,R) (AEC-tr-6316 (p.322-5))
radioinduced free radicals in, oxidation of, 18: 23623(T,R) (AEC-tr-6316 (p.353-8))
radioinduced free radicals in, ultraviolet, 18: 23653(T,R) (AEC-tr-6316 (p.598-602))
radioinduced graft polymerization with polyvinyl pyridine, gamma, 18: 23660(T,R) (AEC-tr-6316(p.672-5))
unpaired electrons in, effects of heat treatment and gamma radiation on, 18: 23398(T,R) (AEC-tr-6316(p.395-400))

ETHYLENE, CHLOROTRIFLUORO- POLYMERS
sorption of americium-241 and protactinium-233 by, from water–ethanol solutions, 18: 23724

ETHYLENE, DICHLORO- POLYMERS
electron back scattering by soybean oil covered by, 18: 23688

ETHYLENE POLYMERS
neutron diffusion in, extrapolation lengths for thermal, 18: 24571(R) (RPI-328-6)
neutron inelastic scattering by, distributions from, 18: 24571(R) (RPI-328-6)
neutron scattering spectrum, 18: 24959 (NP-13910)
oxidation of radioinduced free radicals in, mechanism of, 18: 23621(T,R) (AEC-tr-6316(p.343-5))
radiation effects on electric conductivity of, electron and gamma, 18: 24203
radiation effects on yields of *trans*-vinylene groups in, 18: 24205
radiation effects on thermal stability of, thermogravimetric analysis of, 18: 23673
radioinduced free radicals in, electron spin resonance studies of, 18: 23614(T,R) (AEC-tr-6316(p.283-94))
radioinduced free radicals in, effects of pretreatments on, 18: 23615(T,R) (AEC-tr-6316(p.295-305))
radioinduced free radicals in, singlets in electron spin resonance spectra produced at high doses, 18: 23616(T,R) (AEC-tr-6316(p.306-9))
radioinduced free radicals in, concentration of, 18: 23618(T,R) (AEC-tr-6316(p.314-21))
radioinduced free radicals in, oxidation of, 18: 23619(T,R) (AEC-tr-6316 (p.322-5))
radioinduced free radicals in, oxidation of, 18: 23620(T,R) (AEC-tr-6316 (p.326-42))
radioinduced free radicals produced at low temperature in, electron spin resonance studies of, 18: 23647(T,R) (AEC-tr-6316(p.526-33))
radioinduced graft polymerization of styrene on, gamma, 18: 23589(T,R) (AEC-tr-6316(p.105-13))
radioinduced graft polymerization of acrylonitrile and 2-methyl 5-vinyl pyridine on, 18: 23613(T,R) (AEC-tr-6316(p.266-73))
radioinduced graft polymerization of propene and sulfur dioxide on, gamma, 18: 23642(T,R) (AEC-tr-6316(p.481-97))

ETHYLENE, TETRAFLUORO-
radioinduced polymerization with ethylene, 18: 23626(T,R) (AEC-tr-6316(p.431))
radioinduced polymerization with propene at low temperature, mechanism of, 18: 23684
radioinduced polymerization with 2-methylpropene, infrared spectra, melting points, and x-ray diffraction of products from, 18: 23685
radioinduced polymerization at low temperatures, 18: 23640(T,R) (AEC-tr-6316(p.469-70))

ETHYLENE, TETRAFLUORO- POLYMERS
radiation effects on, gamma and neutron, 18: 24937 (APEX-917)
radioinduced free radicals in, temperature effect of electron spin resonance spectra of, 18: 23644(T,R) (AEC-tr-6316(p.509-15))
radioinduced free radicals produced at low temperature in, electron spin resonance studies of, 18: 23645(T,R) (AEC-tr-6316(p.516-21))
radioinduced reactions with gases, electron spin resonance studies of, 18: 23648(T,R) (AEC-tr-6316(p.534-7))
uses in partition chromatography for separation of selenium from irradiated strontium oxide, 18: 23731
uses in partition chromatography, 18: 23732

ETHYLENE, TRIFLUORO-
reactions with iodine monochloride, effects of ultraviolet light and metal chloride catalysts on, 18: 25016 (UCRL-7373)

EUROPIUM
heat of solution in 0.1*N* hydrochloric acid, 18: 23453 (UCRL-11126)
magnetic properties of, effects of crystalline field and structure on, 18: 24186
polarographic behavior in tetraethylammonium bromide at dropping mercury electrode, 18: 23463
proton reactions (p,γpxn) at 660 Mev, production of neutron-deficient radioactive rare earths in, 18: 24691
separation by sorption on calcium oxalate, 18: 23714
separation from californium, fermium, and mendeleevium by solvent extraction using TBP–nitric acid and TBP–hydrochloric acid system, 18: 23725
separation from rare earths, chromatographic, 18: 23723

EUROPIUM ALLOYS
EuGe$_2$, crystal structure of, 18: 24156

EUROPIUM COMPLEXES
laser action in, 18: 24229
with 2,2′-dipyridyl, preparation and fluorescence and infrared spectra of, 18: 23500

EUROPIUM COMPOUNDS
spectra of, evidence of covalent binding in, 18: 23438 (CONF-405-35)

EUROPIUM IONS
covalency of, spectral evidence of, 18: 23438 (CONF-405-35)
heat of formation of bivalent and trivalent, 18: 23453 (UCRL-11126)

EUROPIUM ISOTOPES Eu-154
beta decay of, circular polarization of 1.28-Mev gamma following, 18: 24668

EUROPIUM ISOTOPES Eu-156
production in neon-22 and oxygen-18 reactions with thorium-232, 18: 24690

EUROPIUM ISOTOPES Eu-157
production in neon-22 and oxygen-18 reactions with thorium-232, 18: 24690

EUROPIUM OXIDES
preparation and thermodynamic properties, 18: 23453 (UCRL-11126)
radiation effects on, gamma and neutron, 18: 24937 (APEX-917)
spectra in low frequency region, infrared, 18: 23549

EXHAUST SYSTEMS
purification of waste gases from internal combustion engines, 18: 23836(P)

EXOSPHERE
electromagnetic radiation in, generation of vlf, 18: 24519
ion streams in, wave amplification from cyclotron instability in, 18: 24790

EXPERIMENTAL BREEDER REACTOR-II
development and operations of, summary, 18: 24952(R) (ANL-6880 (p.6-48))

EXPERIMENTAL GAS COOLED REACTOR
compressor temperature distribution, 18: 24915 (TID-7690(p.166-75))
radiological health manual for, 18: 23820 (EGCR-4)
seals, water-buffered floating-bushing shaft, 18: 24914 (TID-7690 (p.143-65))

EXPLOSIONS
crater nomenclature system for, 18: 25018 (UCRL-7750)

EXPLOSIVES
combustion and thermal decomposition processes in liquid and solid, mechanism of, 18: 25027(T) (LA-tr-64-2)
performance as energy sources for MHD cells, 18: 24365(R) (ASD-TD 63-37)

EXPONENTIAL PILES
buckling and reaction rates in plutonium-graphite, 18: 24852

EXTENSOMETERS
design of high-temperature optical, for measuring creep, 18: 25017 (UCRL-7405)

EYES
radiation effects on corneal epithelium in, proton, 18: 23303
radioinduced cataracts in human, 18: 23313
retinal burns in rabbit, produced by electronically pulsed light source, 18: 23254

F

FALLOUT
analysis of highly radioactive, x-ray microscopic, 18: 23794
contamination of vegetables in Osaka Prefecture from, Oct. 1961 to Dec. 1963, 18: 23797
distribution in milk products, 18: 23800
mobility of particles in, in electric field, 18: 23796
monitoring in air at Chacaltaya, Bolivia, 18: 23803
monitoring in atmosphere, on ground, and in rain water in Osaka Prefecture, 1963, 18: 23793
monitoring in France, 1961, 18: 23799
monitoring in France, 1962 and 1963, 18: 23819 (CEA-R-2409)
monitoring in India, 1962, and 1963, 18: 23789 (AEET/AM/39)
monitoring in North America, 1963 and Jan. 1964, 18: 23804
monitoring in Sweden, 1962, 18: 23790 (NP-13828)
monitoring in 1962 and 1963 after megaton tests, 18: 23798
monitoring of, in high-altitude balloon sampling program, quality control in, 18: 23791(R) (NYO-10496(Add.))
solubility of particles of, in ammonia, hydrochloric acid, fused sodium bisulfate, and fused sodium carbonate, 18: 23795
transport in atmosphere, mechanisms of, 18: 23799

FAST REACTORS
fuel development for liquid-metal-cooled, 18: 24952(R) (ANL-6880 (p.6-48))
fuel elements for lunar, mechanical analysis of, 18: 24943
neutron elastic scattering resonances in, computer program for, 18: 24811 (ANL-6805)
safety analysis of, during excursions, 18: 23817(R) (ANL-6880(p.72-8))
safety of, heat transfer effects in moderate accidents, 18: 24817 (NDA-14-134)

FATS
radiosensitivity effects of phenoxazine on, 18: 23378

FATTY ACIDS
dehydration by plant extracts, 18: 25023(T) (ANL-Trans-21)
radiation effects on metabolism of, gamma, 18: 23302

FEED MATERIALS PRODUCTION CENTER, FERNALD, OHIO
environs monitoring, 1962 and 1963, 18: 23804

FEED MATERIALS PRODUCTION FACTILITY, WELDON SPRINGS, MISSOURI
environs monitoring, 1962 and 1963, 18: 23804

FERMI FAST BREEDER REACTOR
safety of prototype-, heat transfer effects in moderate accidents, 18: 24817 (NDA-14-134)

FERMIONS
electrodynamics of, self-consistency in, 18: 24499
energy of odd-number systems of, BCS determination of ground-state, 18: 24631
gas model of, inhomogeneity corrections with pairing correlations for Thomas-Fermi, 18: 24630
interactions in many-body systems of, correlation effects in, 18: 24461
lifetimes of massive triplets of, 18: 24467
scattering by complex nuclei, polarization in, 18: 24636
theory of ferromagnetic fluids of, 18: 24238

FERMIUM
separation from europium by solvent extraction using TBP–nitric acid and TBP–hydrochloric acid systems, 18: 23725

FERMIUM ISOTOPES Fm-250
yields in heavy ion reactions with thorium and uranium-22, 18: 24689

FERMIUM ISOTOPES Fm-252
yields in heavy ion reactions with thorium and uranium-22, 18: 24689

FERROMAGNETIC MATERIALS
electron spin-wave theory, 18: 24305
neutron scattering by nuclei in, thermal, 18: 24580

FETUSES
malformations of, induced by ingestion of thalidomide by mother, 18: 25010 (TID-19257)
pathological effects of injected strontium-90 in rats, 18: 23244 (UR-643)

FIBRINOGEN
incorporation of iodine-131 in, effects of lysines on deposition of rat, 18: 23219

FIELD THEORY
bibliography on, 18: 24214 (AED-C-23-01)
book: *The Development of Weak Interaction Theory*, a collection of reprints, 18: 24514
bootstrap calculations in SU(3) symmetry, 18: 24431
comparison with s-matrix theory, 18: 24483 (SUI-63-21)
dispersion relations, solutions of partial-wave, 18: 24425
dispersion relations, one-variable, 18: 24427
elemestary particle transformations in, spin ½, 18: 24493
elementary particle transformations, 18: 24494
fermion electrodynamics in, self-consistency in, 18: 24499
five-dimensional formalism in, 18: 24510
formalism for conformal group in Minkowsky space, unitary irreducible representations in, 18: 24498
formalism for ferromagnetic Fermi fluids, 18: 24238
internal symmetries, review on, 18: 24379 (CONF-510-1)
Lorentz invariance of S-matrix in, gauge invariance and equivalence from, 18: 24501
model for quantum, with superconducting solution, 18: 24485
operators in semi-simple groups in, invariant, 18: 24492
particle masses in, gauge, 18: 24437
phonons in quantum, many-body theory of, 18: 24488
Regge trajectories, analytical properties of, 18: 24421
resonance poles in multichannel scattering amplitudes, 18: 24432
scattering amplitudes with unstable particles, resonance poles in, 18: 24433
scattering in, gauge invariance in S-matrix theory of, 18: 24497
superconductivity in, 18: 24545
symmetry group (SU3) in, generators of, 18: 24422
symmetry group coupling Lorentz group and SU$_3$, 18: 24496
weak interactions in, peratization theory of Feinberg and Pais for, 18: 24407
Zachariasen model in, bound states and elementary particles in the limit $Z_3 = 0$ for renormalization constants in, 18: 24458

FILMS
preparation and uses of thin, 18: 23750

FILTRATION
plutonium removal using ultra-, 18: 23190(R) (ANL-6823(p.111-13))

FIRES
extinguishing of, one-man operation of pumper-snorkel for, 18: 23828(R) (UCRL-7637)
simulation in shipping container damage studies, requirements for, 18: 23827 (NYO-2539-1)

FISH
carbon-14 uptake by fresh water, 18: 23223
strontium-90 content of, from Pacific Ocean in vicinity of Japan, 1959 through 1961, 18: 23792 (WP/37)

FISSION
barriers to, liquid-drop theory of, 18: 24670
neutron yield from neutron-induced, energy dependence of, 18: 24640
research program on, using FRM, 18: 24961 (NP-13930(p.80-103))

FISSION CHAMBERS
amplifiers for, design of, 18: 24822 (PWAC-427)
design of spiral, and preparation of coil coated with fissile material, 18: 24038(P)
radiation effects on, 18: 23888 (PWAC-424)

FISSION PRODUCTS
charge of, at A≅130, 18: 24677
containment of gaseous, reactor housing developments for, 18: 24816(R) (NAA-SR-8888(Sect.IV))
content in air and water of swimming pool reactor, 18: 24947 (AEET/AM/38)
determination in irradiated uranium dioxide fuels, 18: 24856(R) (GEAP-4430)
diffusion in graphite, 18: 24073
diffusion of gaseous, grain-boundary movement and, 18: 23566
distributions and yields of, measurements of, 18: 24961 (NP-13930 (p.80-103))
energy conversion devices using, status of, 18: 24371 (RM-3908-PR)
hazards in environment from, after accidental reactor release, 18: 23816 (AHSB(S) R-64)
measurements on, using semiconductor detectors, 18: 24625 (WASH-1046)
monitoring of, in high-altitude balloon sampling program, quality control

  - in, 18: 23791(R) (NYO-10496(Add.))
  - neutron emission by, from uranium-235, 18: 24701
  - release from in-reactor sodium fires, 18: 24891(R) (NAA-SR-8888(Sect.I))
  - retention by sodium reactor coolant, 18: 24816(R) (NAA-SR-8888 (Sect.IV))
  - separation from solvents in plutonium extraction plant by carry-over in water vapor, 18: 23698 (CEA-R-2404)
  - separation of cerium from, by solvent extraction, 18: 23727
  - shipping of, design and hazards evaluation of cask for, 18: 23823 (HW-65268)
- FISSION RECOILS
  - distributions and yields from heavy ion reactions with thorium-232 and uranium-238, 18: 24735
  - distributions of, analysis using nuclear emulsions, 18: 23958
- FISSIUM
  - fissium–Pu–U, development for fast reactor fuels, 18: 24952(R) (ANL-6880(p.6-48))
  - fissium–Pu–U, performance as zero-power reactor fuel, 18: 24952(R) (ANL-6880(p.6-48))
- FLOWMETERS
  - calibration loop for magnetic, 18: 23765 (EUR-1631.d)
- FLUID FLOW
  - burnout in annular flows of subcooled water, 18: 24882(R) (DP-905)
  - dispersion in, effects of longitudinal, on equipment performance, 18: 23755 (UCRL-11157)
  - electrically conducting, in channels, 18: 23777
  - heat transfer in one- and two-phase, in vertical annuli, 18: 23766(R) (GEAP-4431)
  - heat transfer in steam–water and water, through pipes, 18: 24910(R) (SRO-101)
  - measurement by isotropic dilution in pipes, use of pump to reduce mixing length for, 18: 23762 (AERE-R-4623)
  - model for, two-dimensional, 18: 23771 (UCRL-6776)
  - pressure transients and flow stability in reactor coolants, 18: 24816(R) (NAA-SR-8888(Sect.IV))
  - stability of heated-channel, hydrodynamic, 18: 23767 (KAPL-M-6149)
  - through cylindrical MHD channel, electrical effects of, 18: 23773
  - vapor fractions in, in boiling coolant channel, equations for, 18: 23769 (TID-19075)
  - void volume measurements in two-phase, by gamma attenuation and manometer techniques, 18: 23760(R) (ACNP-64022)
- FLUID FUEL REACTORS
  - heat transfer in, analysis of, 18: 23775
- FLUID PROPELLANTS
  - flow in ion engines, feed system for, 18: 23754 (NASA-CR-51)
- FLUIDS
  - dispersion in process equipment, longitudinal, 18: 23755 (UCRL-11157)
  - effects of postirradiation, on radioinduced-saccharin avoidance behavior in rats, 18: 23290
  - interface stability of, effects of compressibility on, 18: 24999 (RM-3953-AEC)
  - theory of ferromagnetic Fermi, 18: 24238
  - transport processes in, general theory of, 18: 24231
- FLUORESCENCE
  - excitation in coatings for thickness measurements, 18: 24046 (PAN-485/I-A)
- FLUORIDE IONS
  - entropy of aqueous, calculation of standard, 18: 23515
- FLUORIDE VOLATILITY PROCESSES
  - performance for plutonium and uranium separation from reactor fuels, 18: 24813(R) (ANL-6880(p.49-67))
- FLUORIDES
  - wetting properties of molten, on graphite and metals, sessile drop observations of, 18: 23437 (CONF-322-12)
- FLUORINE
  - neutron total cross section of, 18: 24625 (WASH-1046)
- FLUORINE ISOTOPES F-18
  - emission in oxygen reactions (O-16,F-18) with rhodium at 160 Mev, distorted wave analysis of, 18: 24719
  - energy levels of, even-parity, 18: 24685
- FLUORINE ISOTOPES F-19
  - deuteron reactions (d,Li-6) at 15 Mev, angular distributions for, 18: 24714
  - helium reactions (He-3,n) at 25 Mev, spectra of, 18: 24650
  - meson (π^-) reaction, cross sections of particle production in, 18: 24587 (JINR-P-1584)
  - neutron reactions (n,p) at 12.5 to 19.6 Mev, cross sections for, 18: 24602 (NP-13930(p.43-9))
  - reactions with light nuclei, gamma spectra of transfer, 18: 24721
  - reactions with rare earths, effective charge distribution from, 18: 24624 (UCRL-10806)
- FLUORINE SYSTEMS
  - F–N, corrosive effects on nickel having weldments, 18: 24813(R) (ANL-6880(p.49-67))
- FLUOROÖRGANIC COMPOUNDS
  - radioinduced polymerization of, 18: 23689
- FLUOROÖRGANIC POLYMERS
  - properties of radiation-produced, evaluation of, 18: 23689
- FOILS
  - neutron activation integrals for, computer program for, 18: 23871 (ANL-6822)
  - preparation and uses of thin, 18: 23750
- FOOD
  - chain, study of marine, 18: 23180 (PG-Report-578)
  - effects on soluble nuclear proteins in rats, 18: 23192(R) (ANL-6823 (p.124-7))
  - fallout monitoring in Swedish, 1962, 18: 23790 (NP-13828)
  - radioactivity in, induced by x or gamma radiation, 18: 23815 (AERE-R-4601)
  - radioactivity of, from fallout in India, 1962 and 1963, 18: 23789 (AEET/AM/39)
  - radiopreservation of meat, feasibility of, 18: 23272
  - radiosterilization of meat, storage following, 18: 23271
  - strontium-90 content in fruits and vegetables, effect of food preparative procedures during canning and freezing on, 18: 23804
- FORMALDEHYDE
  - photolysis in mixtures with ammonium compounds, formation of amino acids in uv, 18: 23204(T) (JPRS-24164(p.19-42))
  - radioinduced polymerization of, effects of solvent and water on, 18: 23598(T,R) (AEC-tr-6316(p.163-7))
  - radioinduced polymerization of input method, 18: 23599(T,R) (AEC-tr-6316(p.168-73))
  - radioinduced polymerication with glyoxal, 18: 23600(T,R) (AEC-tr-6316 (p.174-7))
- FORMALDEHYDE POLYMERS
  - properties of, from radioinduced input polymerization, 18: 23599(T,R) (AEC-tr-6316(p.168-73))
  - radioinduced graft polymerization of vinyl monomers on polyoxymethylene, 18: 23607(T,R) (AEC-tr-6316(p.223-5))
- FORMAMIDE, N,N-DIMETHYL-
  - complexes with uranyl and tetravalent uranium, preparation and polarographic reduction of, 18: 23473
  - effects on radioinduced graft polymerization of styrene on polyvinyl alcohol, 18: 23581(T,R) (AEC-tr-6316(p.66-9))
  - radioinduced polymerization of, effects of ethylene on gamma, 18: 23631(T,R) (AEC-tr-6316(p.439))
- FORMIC ACID
  - photolysis in mixture with ammonium nitrate, formation of amino acids in uv, 18: 23204(T) (JPRS-24164(p.19-42))
- FOSSILS
  - age estimation for mammoth and woolly rhinoceros, by radiocarbon methods, 18: 23788
- FRANCE
  - fallout monitoring, 1962 and 1963, 18: 23819 (CEA-R-2409)
- FREE RADICALS
  - electron spin resonance spectra in irradiated polymers, saturation effects on, 18: 24220(T,R) (AEC-tr-6316(p.603-8))
  - electron spin resonance studies of, in carbon black, 18: 23401(T,R) (AEC-tr-6316(p.660-8))
  - electron spin resonance spectra of, in irradiated polymers, output saturation in, 18: 23617(T,R) (AEC-tr-6316(p.310-13))
  - oxidation of radioinduced, in polymers, 18: 23619(T,R) (AEC-tr-6316 (p.322-5))
  - oxidation of radioinduced, in polyethylene, 18: 23620(T,R) (AEC-tr-6316

- (p.326-42))
- radioinduced formation in polymers, kinetics of, 18: 23654(T,R) (AEC-tr-6316(p.609-15))
- radioinduced in acrylamide and meta-acrylamide, effects of heat treatment on, 18: 23652(T,R) (AEC-tr-6316(p.587-97))
- radioinduced in alcohols, electron spin resonance studies of, 18: 23649(T,R) (AEC-tr-6316(p.538-50))
- radioinduced in cellulose, electron spin resonance study of, 18: 23588(T,R) (AEC-tr-6316(p.100-4))
- radioinduced in polyethylene, electron spin resonance studies of, 18: 23614(T,R) (AEC-tr-6316(p.283-94))
- radioinduced in polyethylene and polypropene, effects of pretreatments on, 18: 23615(T,R) (AEC-tr-6316(p.295-305))
- radioinduced in polymers at high doses, singlets in electron spin resonance spectra, 18: 23616(T,R) (AEC-tr-6316(p.306-9))
- radioinduced in polymers, concentration of, 18: 23618(T,R) (AEC-tr-6316(p.314-21))
- radioinduced in polyethylene, oxidation of, 18: 23621(T,R) (AEC-tr-6316 (p.343-5))
- radioinduced in polypropene, oxidation of, 18: 23622(T,R) (AEC-tr-6316 (p.346-52))
- radioinduced in polyvinyl chloride, oxidation of, 18: 23623(T,R) (AEC-tr-6316(p.353-8))
- radioinduced in polypropene, 18: 23624(T,R) (AEC-tr-6316(p.368-80))
- radioinduced in polyvinyl chloride, role in coloring mechanism, 18: 23625(T,R) (AEC-tr-6316(p.381-94))
- radioinduced in polytetrafluoroethylene, temperature effect of electron spin resonance spectra of, 18: 23644(T,R) (AEC-tr-6316(p.509-15))
- radioinduced in polytetrafluoroethylene at low temperature, electron spin resonance studies of, 18: 23645(T,R) (AEC-tr-6316(p.516-21))
- radioinduced in polycarbonates, electron spin resonance studies of, 18: 23646(T,R) (AEC-tr-6316(p.522-5))
- radioinduced in polyethylene at low temperature, electron spin resonance studies of, 18: 23647(T,R) (AEC-tr-6316(p.526-33))
- radioinduced in polymers by ultraviolet light, 18: 23653(T,R) (AEC-tr-6316(p.598-602))
- radioinduced in sugars, 18: 23651(T,R) (AEC-tr-6316(p.573-86))
- reactions with oxygen after formation during irradiation of potassium palmitate, 18: 23670

FREONS
- physical properties of, systematics in, 18: 24813(R) (ANL-6880 (p.49-67))

FROGS
- radiation effects on temperature adaptation in, 18: 23307
- radioinduced cataracts in eyes of, seasonal variations in, 18: 23268

FRUCTOSE
- protective effects against radiation damage to plant cells, 18: 23374
- radioinduced free radicals in, gamma, 18: 23651(T,R) (AEC-tr-6316 (p.573-86))

FUEL CELLS
- development, 18: 24356 (ANL-6802(p.64-5))
- development of bimetallic and hydride, 18: 24355 (ANL-6802(p.53-63))
- development of mercury–potassium, 18: 24354 (ANL-6802(p.49-52))

FUNGI
- cesium-137 content in mushrooms, 18: 23183

FURAN
- radioinduced polymerization, gamma, 18: 23597(T,R) (AEC-tr-6316 (p.154-62))

FURNACES
- design of electron-beam, 18: 23758(P)

FUSED SALTS
- corrosive effects on metals, stationary potential in, 18: 24089
- properties, 18: 24996(R) (NAA-SR-8888(Sect.VI))

G

GADOLINIUM
- heat of vaporization of liquid, 18: 23439 (CONF-405-36)
- high-temperature allotropy of, 18: 24176
- magnetic properties of, effects of crystalline field and structure on, 18: 24186
- polarographic behavior in tetraethylammonium bromide at dropping mercury electrode, 18: 23463
- proton elastic scattering at 55 Mev, effects of nuclear deformation on, 18: 24665
- separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)
- vapor pressures at 1623 to 1784°K, 18: 23439 (CONF-405-36)

GADOLINIUM ALLOYS
- Gd–Mg, high-temperature allotropy and phase studies on, 18: 24176

GADOLINIUM CARBIDES
- electric conductivity and thermoelectric power at room temperature to 4°K, 18: 23511

GADOLINIUM COMPLEXES
- with EDTA, stereochemistry of, 18: 23518
- with 2,2′-dipyridyl, preparation and fluorescence and infrared spectra of, 18: 23500

GADOLINIUM IONS
- electron paramagnetic resonance in calcium fluorides, spin-lattice relaxation in, 18: 23527

GADOLINIUM ISOTOPES Gd-154
- gamma decay of, circular polarization in, 18: 24668
- oxygen-16 scattering at 38 to 48 Mev, level excitation in, 18: 24729

GADOLINIUM ISOTOPES Gd-156
- oxygen-16 scattering at 38 to 48 Mev, level excitation in, 18: 24729
- proton scattering at 17.5 Mev, coupled-channel analyses of, 18: 24666

GADOLINIUM ISOTOPES Gd-159
- production in neon-22 and oxygen-18 reactions with thorium-232, 18: 24690

GADOLINIUM ISOTOPES Gd-160
- oxygen-16 scattering at 38 to 48 Mev, level excitation in, 18: 24729

GADOLINIUM OXALATES
- dynamic decomposition of, effects of air, carbon dioxide, and nitrogen on, 18: 23507

GADOLINIUM OXIDES
- catalytic effects on deuterium, exchange in cyclohexane, 18: 23573
- magnetic susceptibility at 4.2 to 300°K, 18: 23513
- spectra in low frequency region, infrared, 18: 23549
- CeO_2–Gd_2O_3, equilibrium phase studies on, 18: 23509
- Gd_2O_3–U_3O_8, crystal structure of compacts of, 18: 24813(R) (ANL-6880(p.49-67))

GADOLINIUM PHOSPHATES
- magnetic susceptibility at 20 to 900°K, 18: 23512

GAGES
- design of radiometric, for weighing moving railway vehicles, 18: 24047(P)

GALACTOSE
- radioinduced free radicals in, gamma, 18: 23651(T,R) (AEC-tr-6316 (p.573-86))

GALAXIES
- massive highly condensed objects in, 18: 24277
- radiation from, 18: 24293
- radiation from, 18: 24294
- spectra of, magnetic field effects on Doppler shift of, 18: 24289

GALLIUM
- separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)

GALLIUM ARSENIDES
- photon absorption constants for, 18: 24356 (ANL-6802(p.64-5))

GALLIUM IODIDES
- electric conductivity in iodoethane, iodomethane, and iodopropane solutions, 18: 23449 (PAN-491/V)

GALLIUM ISOTOPES Ga-67
- gamma spectra, 18: 24585(R) (IDO-16969)

GALLIUM ISOTOPES Ga-71
- energy levels of, parity and spin for, 18: 24657

GALLIUM OXIDES
- spectra in low frequency region, infrared, 18: 23549

GAMMA RADIATION
- absorption adjacent to scattering body, calculations, 18: 24218(T,R) (AEC-tr-6316(p.17-23))
- absorption and scattering of thermal-neutron-capture, 18: 24620(R) (ORNL-TM-874)
- absorption by polyvinyl chloride, boundary effect in, 18: 24217(T,R)

(AEC-tr-6316(p.9-16))
analysis of background, in nuclear emulsion, 18: 23929
analysis of background, in nuclear emulsions, 18: 23932
angular correlations in radioisotope decay, spin relaxation in, 18: 24653
biological effects of, effects of procaine on, 18: 23384
chemical effects on nylon, 18: 23579 (NP-13825)
chemical effects on graft polymerization of styrene on polyvinyl alcohol, effects of solvents on, 18: 23581(T,R) (AEC-tr-6316(p.66-9))
chemical effects on graft polymerization of styrene on polyvinyl alcohol, effects of environment on, 18: 23582(T,R) (AEC-tr-6316(p.70-5))
chemical effects on graft polymerization of vinyl monomers on polyvinyl alcohol, 18: 23583(T,R) (AEC-tr-6316(p.76-8))
chemical effects on graft polymerization of styrene on cellulose, 18: 23585(T,R) (AEC-tr-6316(p.84-8))
chemical effects on graft polymerization of styrene on polyethylene and polypropene, 18: 23589(T,R) (AEC-tr-6316(p.105-13))
chemical effects on infrared spectra of polyvinyl alcohol, 18: 23590(T,R) (AEC-tr-6316(p.121-8))
chemical effects on polymerization of vinyl ethers, 18: 23592(T,R) (AEC-tr-6316(p.131-3))
chemical effects on polymerization of acrylonitrile in dimethylformamide, effects of silver nitrate on, 18: 23595(T,R) (AEC-tr-6316(p.145-51))
chemical effects on polymerization of cyclopentadiene, furan, pyrrole, and thiophene, 18: 23597(T,R) (AEC-tr-6316(p.154-62))
chemical effects on polymerization of acetone, bromoacetone, chloroacetone, chlorinated acetone, methyl ethyl ketone, and diacetyl, 18: 23601(T,R) (AEC-tr-6316(p.178-81))
chemical effects on polymerization of diketene, 18: 23603(T,R) (AEC-tr-6316(p.186-9))
chemical effects on reactions of acetaldehyde with isobutene, 18: 23610(T,R) (AEC-tr-6316(p.245-52))
chemical effects on reactions between acetaldehyde and ethylene, 18: 23611(T,R) (AEC-tr-6316(p.253-60))
chemical effects on ethylene–2-propanol mixtures, 18: 23612(T,R) (AEC-tr-6316(p.261-5))
chemical effects on graft polymerization of acrylonitrile and 2-methyl 5-vinyl pyridine on polyethylene, 18: 23613(T,R) (AEC-tr-6316 (p.266-73))
chemical effects on polyvinyl chloride, oxidation of free radicals produced in, 18: 23623(T,R) (AEC-tr-6316(p.353-8))
chemical effects on reactions of acetylene with chlorine at low temperatures, 18: 23629(T,R) (AEC-tr-6316(p.436))
chemical effects on polymerization of dimethylformamide in presence of ethylene, 18: 23631(T,R) (AEC-tr-6316(p.439))
chemical effects on polymerization of 4-vinyl pyridine, 18: 23632(T,R) (AEC-tr-6316(p.440))
chemical effects on polymerization of 5-ethyl 2-vinyl pyridine, 18: 23633(T,R) (AEC-tr-6316(p.441))
chemical effects on polymerization of chloral, 18: 23634(T,R) (AEC-tr-6316(p.442))
chemical effects on crosslinking of natural rubber in presence of sulfur dioxide, 18: 23637(T,R) (AEC-tr-6316(p.449-55))
chemical effects on polymerization of isoprene, 18: 23638(T,R) (AEC-tr-6316(p.456-64))
chemical effects on polymerization of acrylonitrile–urea, 18: 23639(T,R) (AEC-tr-6316(p.465-8))
chemical effects on polymerization of acrolein diethyl acetal, 18: 23641(T,R) (AEC-tr-6316(p.471-80))
chemical effects on graft polymerization of propene and sulfur dioxide on polyethylene, 18: 23642(T,R) (AEC-tr-6316(p.481-97))
chemical effects on graft polymerization of styrene on viscose cellulose, 18: 23643(T,R) (AEC-tr-6316(p.498-500))
chemical effects on reactions of Teflon with gases, 18: 23648(T,R) (AEC-tr-6316(p.534-7))
chemical effects on sugars, 18: 23651(T,R) (AEC-tr-6316(p.573-86))
chemical effects on free radicals in polyvinyl alcohol, 18: 23654(T,R) (AEC-tr-6316(p.609-15))
chemical effects on oxidation of phenylcyclohexane, 18: 23656(T,R) (AEC-tr-6316(p.623-39))
chemical effects on graft polymerization of vinyl monomers on polyethylene terephthalate, 18: 23657(T,R) (AEC-tr-6316(p.640-9))
chemical effects on graft polymerization of vinyl monomers on cotton and rayon, 18: 23658(T,R) (AEC-tr-6316(p.650-9))
chemical effects on graft polymerization of polyvinyl chloride and polyvinyl pyridine, 18: 23660(T,R) (AEC-tr-6316(p.672-5))
chemical effects on polyisobutylene, 18: 23669
chemical effects on cis-trans transformation of natural rubber, 18: 23636(T,R) (AEC-tr-6316(p.444-8))
detection and measurement using nuclear emulsion, 18: 23912
detection and measurement using thallium-activated sodium iodide scintillators, nanosecond resolving time for, 18: 23979
detection and measurement of, rocket instrumentation for, 18: 23992
dose measurements at TRIGA F reactor, 18: 24957 (NRL-TR-59)
dose rate measurements within and behind beryllium oxide, 18: 24806 (XDC-61-1-149)
dosimetry of, silicon junctions for, 18: 23967
effects on bean seed cytology, 18: 23252(T) (ORNL-tr-84)
effects on blood formation in dogs, chronic-exposure, 18: 23305
effects on *Callosobruchus subinnotatus*, 18: 23270
effects on chick embryos, 18: 23229(R) (ANL-6823(p.5-14))
effects on clays and soils, 18: 23171
effects on cotton cells, 18: 23300
effects on cytoplasmic movement, 18: 23274
effects on dislocations in copper, annealing effects on, 18: 24209
effects on electric conductivity of glass, polyethylene, and poly(methyl methacrylate), 18: 24203
effects on electric conductivity of chloral hydrate, dose rate effects in, 18: 23663
effects on fatty acid metabolism in rabbits and rats, 18: 23302
effects on HeLa cell survival, 18: 23280
effects on Initial Engine Test components, 18: 24937 (APEX-917)
effects on luminosity of aqueous solutions of sodium salicylate, 18: 23580 (PAN-488/XVII)
effects on monkey testes, 18: 23330
effects on mouse and rat reproduction, 18: 23328
effects on mouse reproduction, 18: 23326
effects on mouse reproduction, 18: 23329
effects on potassium iodates in basic aqueous solutions, 18: 23674
effects on primitive germ cells of prepubertal bovine testes, 18: 2327
effects on protein electron spin resonance patterns, 18: 23289
effects on protein metabolism in adrenal glands of guinea pigs, 18: 23321
effects on reactor pressure vessels, measurement of, 18: 23780(R) (SWRI-1243-11)
effects on reproduction in rats, 18: 23343
effects on *Rhizopus stolonifer* spores, protective effects of germinatio inhibition and oxygen against, 18: 23288
effects on ribonuclease, 18: 23295
effects on sintered uranium carbide pellets, 18: 24072(T,R) (EURAEC-934)
effects on sperm metabolism, 18: 23334
effects on spermatozoa metabolism in bulls, 18: 23297
effects on sprouting of onion bulbs, 18: 23255
effects on sterility in cotton moth, 18: 23283
effects on strontium nitrate single crystal centers, 18: 23474
effects on survival and tumorigenesis in mice, 18: 23230(R) (ANL-6823(p.15-19))
effects on temperature adaptation of frogs, 18: 23307
effects on thermal stability of polyethylene, thermogravimetric analysis 18: 23673
effects on thermocouples, design of apparatus for studying, 18: 2384 (RT/ING(64)-2)
effects on tissue cultures, effects of phosphate buffer on, 18: 23375
effects on unpaired electrons in polyvinyl chloride, 18: 23398(T,R) (AEC-tr-6316(p.395-400))
effects on uranium carbides, in-pile, 18: 24860(R) (UNC-5071)
effects on urinary reducing system in beagles, 18: 23184(R) (ANL-6823(p.44-75))
effects on yields of *trans*-vinylene groups in, 18: 24205
emission in neutron capture by manganese and copper, 18: 24699
emission in transfer reactions at 6.2 and 9.6 Mev, spectra of, 18: 2472
emission in Y* decay, 18: 24387 (JINR-P-1615)
energy distributions in reactors, effects of core division by moderator material on, 18: 24849 (NP-13930(p.130))

energy measurement above 15 Mev, design of quantometer for, 18: 23899
exchange between nitrogen-14 and -15 induced in gaseous nitrogen by, mechanism of, 18: 23680
genetic effects on phages, 18: 23269
genetic effects on Rhesus monkey at 5 to 400 r, 18: 23317
inactivation of virus by, 18: 23246(T) (AERE-Trans-1000)
industrial uses in measuring coating thicknesses, 18: 24046 (PAN-485/I-A)
interactions with protons at 950 to 1050 Mev, Λ^0 polarization in, 18: 24428
interactions with protons, meson (π) production in, 18: 24474
interactions with protons, excitation curves for meson production in, 18: 24381 (ISS-64/4)
interactions with hyperons (Λ), resonance, 18: 24387 (JINR-P-1615)
ionization by, in nuclear plasma diodes, 18: 24373
monitoring, 18: 23901
performance for polymerizing fluoroörganic compounds, 18: 23689
polymerization of propene with tetrafluoroethylene induced by, mechanism of, 18: 23684
polymerization of 2-methylpropene with tetrafluoroethylene induced by, alternating crystalline copolymer yields in, 18: 23685
production in meson (π)-proton interactions at 9 Bev, forward, 18: 24417
radioactivity in foods induced by, 18: 23815 (AERE-R-4601)
reactions (γ,α) with emulsion nuclei, 18: 23930
reactions (γ,d) with tritium, nucleon rigid-core analysis of, 18: 24705
reactions (γ,p) with lithium-6 at 5.7 to 20 Mev, angular and energy distributions from, 18: 24695
reactions $(\gamma,2n)p$ with tritons, cross section with final-state (n-n) interaction for, 18: 24632
reactions with lithium-6 at 5.7 to 19 Mev, cross sections for, 18: 24695
reactions with silver nitrates, decomposition in, 18: 23687
scattering by atomic electrons at 280 kev, small-angle, 18: 24412
spectra in deuteron-meson (π^-) interactions, 18: 24462
sterility induced in insects by, effects of air and carbon dioxide on, 18: 23276

GAMMA SOURCES
calibration of encapsulated radium, tables of corrections for, 18: 23387 (ISS-64/2)

GAMMA SPECTRA
analysis by least squares method, 18: 23434
analysis of neutron-capture, 18: 24620(R) (ORNL-TM-874)
recording of erratic time-distributed, closed magnetic loop for, 18: 24001
tabulations of, from neutron-deficient isotopes, 18: 24585(R) (IDO-16969)

GAMMA SPECTROMETERS
design of automated fast coincidence, 18: 23892 (USNRDL-TR-729)
magnetic recording system for, 18: 24001
sample changer for scintillation-well, automatic, 18: 23873 (HW-80798)
uses of lead, in neutron capture studies, 18: 24608 (NP-13930(p.110-11))

GAMMA SPECTROSCOPY
of neutron-deficient isotopes, 18: 24585(R) (IDO-16969)
use of semiconductor detectors in, 18: 23989

GAS COOLED REACTORS
bearing and seal design for, 18: 23742 (TID-7690(p.106-20))
bearings for, hydrostatic gas, 18: 23748 (TID-7690(p.303-12))
bearings for, multi-pad gas, 18: 23746 (TID-7690(p.263-72))
bearings for, pressure in gas-lubricated, tilting-pad, journal, 18: 23747 (TID-7690(p.273-302))
blower design for, 18: 23741 (TID-7690(p.102-5))
circulators for A.V.R. Brown Boveri-Krupp, primary, 18: 24912 (TID-7690(p.1-15))
compressors for, high-temperature helium, 18: 23745 (TID-7690 (p.236-44))
conference on rotating machinery for, Gatlinburg, Tenn., Nov. 1963, 18: 24911 (TID-7690)
coolant flow in GCR-4, turbo-circulator for, 18: 24913 (TID-7690 (p.16-75))
coolant monitoring in, equipment for, 18: 24839(P)
cooling system for, design of expansion joint for, 18: 24835(P)
design, 18: 24919(T) (ORNL-tr-82)
design and development of Latina, 18: 24923
graphite oxidation and mass transport in, facility for studying, 18: 23447 (ORNL-TM-831)
rotors for, rotary damping in stability of flexible, 18: 23749 (TID-7690(p.313-30))
seal systems for, 18: 23743 (TID-7690(p.121-42))
seals for, welded-metal-bellows shutdown, 18: 24823 (TID-7690 (p.176-88))

GAS FLOW
analysis of one-dimensional, use of digital computer for, 18: 23772 (UCRL-7530)
in electric and magnetic fields, 18: 24746 (ARL-64-34)
relations in rotational MGD, reciprocal, 18: 23778
theory for, review on, 18: 24764 (UTIAS-Rev-18)

GASEOUS DIFFUSION PLANTS
economics of toll enrichment in, 18: 24866

GASEOUS DIFFUSION PROCESS
economics of, for uranium enrichment, 18: 24054(T) (ORNL-tr-134)

GASES
determination in high and ultrahigh vacuum systems, design of mass spectrometer for, 18: 23433
dynamics of rarified, review on, 18: 24764 (UTIAS-Rev-18)
electron collisions with neutral heat dissipation by, 18: 24740(R) (AD-426769)
ionization in nuclear plasma diodes, 18: 24373
quantum statistics of, with Coulomb interaction, 18: 24489
reactions with graphite in reactor core, facility for studying, 18: 23447 (ORNL-TM-831)
reactions with solids, role of chemisorption in, 18: 25033(T) (SC-T-64-901)
separation of mixtures of, design of apparatus for, 18: 23737(P)
shock wave thermodynamics in, 18: 24303
steady-state calculations for non-equilibrium problems in, 18: 24233
thermal ionization in mixtures of, effects of electronegative species on, 18: 23532

GASTROINTESTINAL TRACT
radiosensitivity of, in rats, 18: 23237 (FSU-2690-15(Paper 3))

GATING SYSTEMS
design and performance of fast linear transmission gate, 18: 23863

GEIGER-MUELLER TUBES
design of liquid-sample halogen, with high beta sensitivity and low background, 18: 24037(P)

GELATIN
deformation by cylindrical projectiles, 18: 25001(R) (SC-DC-64-459)
preparation and processing of ionographic-emulsion, 18: 23496
uses of foams of, in separation of strontium and yttrium, 18: 23735

GENERAL ELECTRIC TEST REACTOR
in-pile loop operation for testing uranium dioxide fuel in pressurized water, 18: 24855(R) (GEAP-3771-12)

GENES
radioinduced translocation of Drosophila, linear dose dependence of, 18: 23282

GENETICS
effects of radiomimetic agents on mouse, 18: 23177
effects of strain on radiosensitivity of mice, 18: 23251(T) (JPRS-24803)
of blue-green algae, 18: 24997 (NYO-3046-1)
radiation effects on *Aedes aegypti*, x, 18: 23262
radiosensitivity of DNA regulatory mechanism in, 18: 23269
role of peptides in genetic code of DNA, 18: 25011 (TID-20348)

GEOLOGY
instruments and methods of, for detection of underground formations and materials, 18: 23781 (NP-13943)
research progress in, in Communist China, selected translations on, 18: 25025(T) (JPRS-24552)

GEOMAGNETIC FIELDS
activity at conjugate points, 18: 24531
boundary of magnetosphere, observations on, 18: 24749 (CONF-521-2)
disturbances at conjugate areas in, from solar corpuscular radiation, 18: 24526
ion streams in, wave amplification from cyclotron instability in, 18: 24790
variations during solar quiet days from local increase of ionospheric conductivity, 18: 24527

GEOMAGNETIC STORMS
classification using energy character figure, 18: 24530
correlation with ionospheric disturbances, 18: 24534
effect on equatorial spread-F, 18: 24535
effects on polar cap absorption, 18: 24520
solar effects on sudden commencement of, 18: 24518
GEOPHYSICS
relation between speed of earth rotation and solar activity, 18: 24528
GERMANIUM
electric conductivity and carrier life in, 18: 25030(T) (ORNL-tr-120)
electron configuration of, g factors of p^3, 18: 24625 (WASH-1046)
photon absorption constants for, 18: 24356 (ANL-6802(p.64-5))
preparation of high-purity, 18: 25030(T) (ORNL-tr-120)
GERMANIUM ALKYLS
germanium-73 proton spin-spin coupling in, 18: 23561
GERMANIUM ALLOYS
EuGe$_2$, crystal structure of, 18: 24156
Ge$_3$Mo, shear modulus and sound velocity of, 18: 24174
GERMANIUM COMPOUNDS
organic, separation of phenyl, from arsenic phenyl compounds by partition chromatography, tracer studies of, 18: 23733
GERMANIUM ISOTOPES Ge-69
gamma spectra, 18: 24585(R) (IDO-16969)
GERMANIUM ISOTOPES Ge-73
spin coupling in tetramethyl germanium, 18: 23561
GERMANIUM OXIDES
spectra in low frequency region, infrared, 18: 23549
GERMINATION
protective effects of inhibition of, against gamma radiation in *Rhizopus stolonifer*, 18: 23288
GLASS
cesium ion infrared absorption spectra in, 18: 23459(T) (JPRS-24593 (p.37-41))
laser characteristics of barium crown, doped with neodymium and uranyl ions, 18: 24223
radiation effects on electric conductivity of, electron and gamma, 18: 24203
radiation effects on potassium-aluminoborate, alleviation by additives, 18: 24813(R) (ANL-6880(p.49-67))
sorption of americium-241 and protactinium-233 by, from water–ethanol solutions, 18: 23724
uranium content of ancient man-made, 18: 23547
GLOBULIN
radiation effects on dog, x, 18: 23306
GLOW DISCHARGES
electric field effects on, high-frequency, 18: 24796
GLUCONIC ACIDS
photolysis in mixture with ammonium carbonate, formation of amino acids in uv, 18: 23204(T) (JPRS-24164(p.19-42))
GLUCOSE
inhibitory effects on mouse catalase levels of oxidase of, 18: 23186(R) (ANL-6823(p.86-90))
protective effects against radiation damage to plant cells, 18: 23374
radioinduced free radicals in, gamma, 18: 23651(T,R) (AEC-tr-6316 (p.573-86))
GLUTAMIC ACID
photolysis of, transformation of amino acids in uv, 18: 23204(T) (JPRS-24164(p.19-42))
synthesis and transformation in uv photolysis of organic compounds in mixtures with ammonium compounds, 18: 23204(T) (JPRS-24164 (p.19-42))
GLUTEN
isotope effects of heavy water on physical properties, 18: 23477
GLYCEROL
protective effects against radiation damage to plant cells, 18: 23374
radiation effects on, gamma and neutron, 18: 24937 (APEX-917)
GLYCINE
nitrogen-15 NMR in, chemical shifts in, 18: 23530
photolysis of, transformation of amino acids in uv, 18: 23204(T) (JPRS-24164(p.19-42))
synthesis and transformation in uv photolysis of organic compounds in mixtures with ammonium compounds, 18: 23204(T) (JPRS-24164 (p.19-42))
GLYCINE SULFATES
radiation effects on polarization in, 18: 23671
GLYOXAL
radioinduced polymerization of, gamma, 18: 23600(T,R) (AEC-tr-6316 (p.174-7))
GLYOXIME, DIMETHYL-
analytical uses in determination of 50 to 500 ppm nickel in thorium, 18: 23414 (Y-1464)
GOLD
efficiency drift of foil of, in secondary electron monitor for linear accelerator at 15 Mev, 18: 24253
electron scattering at 1 to 15 kev, angular distributions for, 18: 24
growth of films of, sputtering, 18: 24074
neutron activation of, absolute thermal flux measurements by, 18: 23 (KFK-180)
neutron capture cross section of, fast, 18: 24625 (WASH-1046)
neutron capture gamma spectra, 18: 24625 (WASH-1046)
neutron scattering by, 18: 24625 (WASH-1046)
proton elastic scattering at 55 Mev, effects of nuclear deformation on, 18: 24665
radiation effects on crystalline, electron, 18: 24996(R) (NAA-SR-8888(Sect.VI))
separation from other radioisotopes produced in irradiation of bismuth by partition chromatography on teflon, 18: 23732
separation from other radioisotopes produced in irradiation of bismuth by partition chromatography on teflon, 18: 23732
sorption of americium-241 and protactinium-233 by, from water–ethanol solutions, 18: 23724
superconductivity, 18: 24179
wetting by molten chlorides and fluorides, sessile drop observations, 18: 23437 (CONF-322-12)
GOLD ALLOYS
superconductivity of metastable intermetallic compounds in, 18: 241 (TID-20617)
superconductivity, 18: 24179
Au–Fe, ferromagnetism at low temperatures in dilute, 18: 24143 (UCRL-7390)
Au–Mn, radiation and heat-treatment effects on electric and magnetic properties, 18: 24210
GOLD ISOTOPES Au-196
gamma spectra, 18: 24585(R) (IDO-16969)
GOLD ISOTOPES Au-197
neutron radiative capture cross sections at 20 to 200 kev, 18: 2459 (LMSC-4-50-62-1)
neutron reactions (n,y) at 12 to 680 kev, cross section for, 18: 2462 (WASH-1046)
use in measurement of Doppler coefficients of reactivity, 18: 2481 (NAA-SR-8888(Sect.IV))
GOLD ISOTOPES Au-198
gamma spectra, 18: 24591(R) (LMSC-4-50-62-1)
water uptake by soil measured by, 18: 24045
GOLD ISOTOPES Au-199
separation from platinum by cation exchange, 18: 23718
GOLD OXIDES
spectra in low frequency region, infrared, 18: 23549
GONADS
effects of estrogenic hormones on rat, comparison of, with radiation effects, 18: 23332
effects of sex hormones on endogenous respiration in x-irradiated rat, 18: 23333
irradiation of, in breast cancer patients, effects of, on urinary estrog 18: 23346
radiation dose to mouse, after strontium-90 and yttrium-90 injection, 18: 23185(R) (ANL-6823(p.76-80))
radiation effects on primitive germ cells in prepubertal bovine, 18: 23
radiation effects on, 18: 23323
radiation effects on monkey, gamma, 18: 23330
radiation effects on rat, comparison of electron, with effects of estrog hormones, 18: 23332
radiation effects on hamster accessory, 18: 23336
radiation effects on bull semen after irradiation of, x, 18: 23337

radiation effects on lamb, x, 18: 23338
radiation injury to chromosomes in, protection against, using streptomycin, 18: 23359(T) (JPRS-24593(p.120-5))
radiation- and hydrocarbon-induced tumors in rodent, 18: 23349
GRANITES
physical properties of, effects of underground nuclear explosions on, 18: 23786 (UCRL-13105)
GRAPHITE
creep at 2300 to 2900°C, tensile, 18: 24147 (WADD-TR-61-72 (Vol.XVIII))
crystal structure defects in, sensitivity of radiographic methods for detecting, 18: 24146 (WADD-TR-61-72(Vol.XVII))
diffusion of fission products in, 18: 24073
elastic constants of polycrystalline, model for, 18: 23567
electron bombardment of films of, products from, 18: 24319
fabrication of articles of pyrolytic, 18: 24114(P)
fabrication of impermeable composite tubes of, 18: 24117(P)
neutron moderation in, 18: 24888 (HW-SA-3507)
oxidation by gases in reactor core, facility for studying, 18: 23447 (ORNL-TM-831)
oxidation of reactor, thermal, 18: 24090
oxidation resistance of, effects of additive oxidation to form coating on, 18: 24087 (WADD-TR-61-72(Vol.XXX))
preparation by pressure curing process, property improvement by, 18: 24071 (WADD-TR-61-72(Vol.XII))
preparation of boron-free, process for, 18: 23520(P)
radiation effects on oxidation kinetics of, in acid solutions, 18: 24202(T) (GA-tr-5174)
radiation effects on neutron elastic scattering by, neutron, 18: 24207
radiation effects on, 18: 24073
reactions with molten sodium fuel, capsule irradiation test on, 18: 24907 (ORNL-TM-870)
surface structure of, field-emission microscopic studies of, 18: 24121 (ANL-6804)
tensile properties of ZTA grade artificial, at 0 to 2760°C, 18: 24145 (WADD-TR-61-72(Vol.XIV))
wetting by molten chlorides and fluorides, sessile drop observations, 18: 23437 (CONF-322-12)
GRAPHITE MODERATED REACTORS
design and development of Latina, 18: 24923
design of gas-cooled, integrated, 18: 24919(T) (ORNL-tr-82)
neutron buckling and reaction rates in plutonium-graphite exponential assemblies, 18: 24852
neutron moderation in, graphite-water ratio effects on, 18: 24888 (HW-SA-3507)
GRAPHITE SYSTEMS
oxidation resistance of effects of protective coating of oxidation products on, 18: 24087 (WADD-TR-61-72(Vol.XXX))
C–ThC–UC, separation of uranium from chlorinated, by solvent extraction, 18: 23703 (ORNL-TM-789)
GRAVITATION
production by electromagnetic fields, structure of, 18: 24487
quantization of, equivalence of Feynman and canonical, 18: 24232
theory of, gyroscope motion in, 18: 24511
GREAT BRITAIN
transport of sea drifters at Solway Firth, tracer study, 18: 23785 (PG-Report-577)
GROUND
blast effects of underground nuclear explosions on, 18: 23783 (NP-13943(p.209-14))
deformation by cylindrical projectiles, 18: 25001(R) (SC-DC-64-459)
fallout monitoring in Osaka Prefecture, 1963, 18: 23793
inspection for buried objects, using x-ray backscatter, 18: 23782 (NP-13943(p.117-27))
inspection of, for detection of formations and objects, 18: 23781 (NP-13943)
GROUND WATERS
flow measurement using tracer techniques, 18: 24979(T,R) (EURAEC-202)
flow measurement using tracer techniques, 18: 24980(T,R) (EURAEC-300)
GROWTH
iodine-131-labeled hormones for human, techniques for rapidly producing, 18: 23225
radiation effects on rat, thyroid function in, x, 18: 23260
GUANIDINE, 1,1′-(DITHIODIETHYLENE)DI-
radiosensitivity effects on bean roots, 18: 23379
GUINEA PIGS
activation and inactivation of *p*-hydroxyphenylpyruvic acid oxidase in liver of, 18: 25009 (TID-19079)
radiation effects on metabolic and phagocytic activities of polymorphonuclear leukocytes in, 18: 23242(R) (TID-20379)
radiation effects on protein metabolism in adrenal glands of, 18: 23321
GYPSUMS
solubility in rare earth chloride solutions, 18: 23536

H

HAFNIUM
corrosion by liquid potassium chloride–sodium chloride at 700, 800, and 900°C, 18: 24089
economic and technological review of, 18: 24076
neutron resonance capture by, gamma spectra from, 18: 24625 (WASH-1046)
separation from zirconium by countercurrent extraction, 18: 23739(P)
HAFNIUM ALLOYS
Hf–Ta–W, factors affecting vacuum-arc melting of, 18: 24070 (RTD-TDR-63-4089)
HAFNIUM BORIDES
development for high-temperature oxidation protection of tungsten, 18: 24086(R) (NP-13898)
HAFNIUM CARBIDES
electric properties of, rigid band model for interpreting, 18: 24137 (NP-13944)
HAFNIUM ISOTOPES Hf-176
neutron resonance capture at 30 to 1200 ev, 18: 24571(R) (RPI-328-6)
HAFNIUM ISOTOPES Hf-177
neutron resonance capture at 30 to 1200 ev, 18: 24571(R) (RPI-328-6)
HAFNIUM ISOTOPES Hf-178
neutron resonance capture at 30 to 1200 ev, 18: 24571(R) (RPI-328-6)
HAFNIUM ISOTOPES Hf-179
neutron resonance capture at 30 to 1200 ev, 18: 24571(R) (RPI-328-6)
HAFNIUM ISOTOPES Hf-180
neutron resonance capture at 30 to 1200 ev, 18: 24571(R) (RPI-328-6)
HAFNIUM NITRIDES
electric properties of, rigid band model for interpreting, 18: 24137 (NP-13944)
HAFNIUM OXIDES
spectra in low frequency region, infrared, 18: 23549
HAIR
iodine-131 content in, of man and rats, 18: 23207(T) (JPRS-24704 (p.6-11))
HALIDE COMPLEXES
with uranium, stability constants of, 18: 23534
HALLAM POWER REACTOR
fuel surveillance program for, 1963 summary, 18: 24892(R) (NAA-SR-8888(Sect.II))
operation, 18: 24878 (CONF-504-3)
HAMSTERS
electron microscopic studies of chromosomes during metaphase in tissue cultures of cells from, 18: 25008 (TID-19032)
radiation effects on gametes and zygotes in, 18: 23327
radiation effects on accessory sex organs in male, 18: 23336
radiation effects on reproduction in female, x, 18: 23344
HANDBOOKS AND MANUALS
Master Analytical Manual, ORNL, 18: 23410 (TID-7015(Suppl.6))
radiological health manual for operation of Experimental Gas Cooled Reactor, 18: 23820 (EGCR-4)
HANFORD PRODUCTION REACTORS
coolant for, purification of water for use as, 18: 23443 (HW-77710)
HANFORD PRODUCTION REACTORS (N)
coolant purity in, monitoring system for, 18: 24932 (HW-SA-3018)
HASTELLOY F
performance in nuclear-superheater environment, 18: 24886(R)

(GEAP-4565)

HASTELLOY X

performance as fuel cladding in fast reactors, 18: 24952(R) (ANL-6880(p.6-48))
performance in nuclear-superheater environment, 18: 24886(R) (GEAP-4565)
performance in nuclear superheater environment, 18: 24884(R) (GEAP-4419)
radiation effects on, gamma and neutron, 18: 24937 (APEX-917)

HAYNES 25 ALLOY

coating with Solaramic 5210-2c glass, 18: 24085(R) (NASA-CR-54053)
corrosion by lithium and lithium hydrides at 1165 to 1600°F, 18: 24085(R) (NASA-CR-54053)

HEALTH PHYSICS

control measures for British research reactors, 18: 23810 (AERE-R-4528(p.1-24))
manual for operation of Experimental Gas Cooled Reactor, 18: 23820 (EGCR-4)

HEART

radiation effects on, tissue culture of, effects of phosphate buffer on, 18: 23375

HEAT EXCHANGERS

testing in reactor cooling system, 18: 24881 (DLCS-4140301)

HEAT TRANSFER

analysis of fluid-fuel-reactor, 18: 23775
analysis of heterogeneous-water-reactor, 18: 23776
burnout in subcooled-water flows in annuli, 18: 24882(R) (DP-905)
by electrically heated wire screen matrix, effects of air blockages on, 18: 23764 (APEX-724)
by film condensation of liquid metal vapors, 18: 23768 (MIT-2995-1)
by shield plug in Maritime Nuclear Steam Generator, 18: 24939(R) (GEMP-285)
in fast reactors, effects on moderate accidents, 18: 24817 (NDA-14-134)
in nuclear seaplane power plant, analysis of, 18: 24935 (APEX-260)
in one- and two-phase flows through vertical annuli, 18: 23766(R) (GEAP-4431)
in one-phase liquid flows near critical point, 18: 24813(R) (ANL-6880(p.49-67))
in steam–water and water flows through pipes, 18: 24910(R) (SRO-101)

HEAT TRANSFER SYSTEMS

operation of Sodium Component Test Installation during 1963, 18: 24891(R) (NAA-SR-8888(Sect.I))
operation of sodium shell-and-tube equipment for ASCR, 18: 24891(R) (NAA-SR-8888(Sect.I))

HEAT TREATMENT

effects on electric and magnetic properties of gold–manganese alloys, 18: 24210

HEAVY WATER REACTORS

feasibility of light-water-cooled, 18: 24882(R) (DP-905)
fuel cost analysis for natural-uranium, 18: 24905 (NP-13905)
fuel elements for, development of, 18: 24882(R) (DP-905)
operation of Canada-India, 18: 24949 (AEET/ROD/7)
performance of Canada-India Reactor, 18: 24948 (AEET/ROD/6)

HELIUM

deuterium and deuteron reactions at 20 Mev, electron detachment in, 18: 24310
diffusion in irradiated beryllium oxides, 18: 24065(R) (GEMP-34A)
electric discharge in, stability of, 18: 24784
electric discharge in, microwave resonance emission spectra of, 18: 24772
electron reactions with ions in plasma of, energy balance and recombination in, 18: 24794
electron temperature in plasma of, 18: 24744 (ANL-6802(p.113-19))
hydrogen ion reactions at 10 to 180 kev, dissociation in, 18: 24324
ion motion in liquid, 18: 24739(R) (AD-417496)
neutron double scattering at 23 Mev, 18: 24625 (WASH-1046)
pinch discharge in, spectral line profiles in Z, 18: 24791
plasma of, ionization and recombination in steady-state, 18: 24751 (EUR-CEA-FC-200)
purification of, design of apparatus for, 18: 23519(P)
purification of, facility for evaluating methods of, 18: 23447 (ORNL-TM-831)
reactions with helium and hydrogen atoms, short-range, 18: 24313
repulsion of hydrogen atoms by, energy of, 18: 24306
separation of iodine vapors from, by adsorption on charcoal, 18: 23386 (CONF-12-3)
use as coolant in Maritime Nuclear Steam Generator, thermodynamic evaluation of, 18: 24939(R) (GEMP-285)
use in measuring recoil range straggling in heavy ion reactions, 18: 24734

HELIUM ION BEAMS (He-3)

production of divalent, 18: 24625 (WASH-1046)

HELIUM IONS

motion in liquid-helium plasma, 18: 24739(R) (AD-417496)
reactions (He^3,n), 18: 24625 (WASH-1046)
reactions (He-3, He-4) with fissioning nuclei, 18: 24625 (WASH-1046)
reactions (He-3,d) with nuclei from A = 50 to 65, 18: 24625 (WASH-1046)
reactions with nuclear emulsions, effects of energy and mass on grain darkening in, 18: 23916
scattering by oxygen-16 at 65 Mev inelastic, 18: 24623 (UCRL-10727)

HELIUM ISOTOPES

spectrum of solar, 18: 24326

HELIUM ISOTOPES He-3

deuteron reactions (d,n) and (d,t) with, 18: 24625 (WASH-1046)
helium ion reactions (He^3,2p) with, 18: 24625 (WASH-1046)
reactions (He-3,n) with nuclei at 25 Mev, spectra of, 18: 24650
reactions (^{3}He,d) with yttrium-89 at 22 Mev, zirconium-90 energy levels from, 18: 24663
reactions with nickel-58 and -60, deuteron angular distributions from, 18: 24590 (LADC-6370)
scattering by helium-4 at 1 to 50 Mev, two-nucleon forces in, 18: 24711

HELIUM ISOTOPES He-4

deuteron scattering at 4 to 7.5 Mev, tensor polarization in, 18: 24647
helium reactions (He-3,n) at 25 Mev, spectra of, 18: 24650
helium-3 scattering at 1 to 50 Mev, two-nucleon forces in, 18: 24711
ion motion in II form, 18: 24739(R) (AD-417496)
proton elastic scattering by, distributions from, 18: 23948

HELIUM SYSTEMS

He–K, production of supersonic plasma of, 18: 24743 (ANL-6802 (p.29-36))
He–O, oxygen vibrational de-excitation in, 18: 24315

HEMATOLOGY

radiation effects on rat, x, 18: 23296

HEMATOPOIETIC SYSTEM

radiation effects on function of, chronic-exposure, 18: 23305
radiosensitivity, 18: 23245 (UR-654)

HETEROGENEOUS REACTORS

heat transfer in, transient, 18: 23776
moderator structure for, design of, 18: 24838(P)
neutron moderation in, graphite-water ratio effects on, 18: 24888 (HW-SA-3507)

HIGH-ALTITUDE EXPLOSIONS

fallout from 1961 and 1962 megaton nuclear, 18: 23798

HIGH-TEMPERATURE CORROSION

of metals by gases, electrical process for protection against, 18: 24092(P)

HIGH TEMPERATURE GAS COOLED REACTOR EXPERIMENT

circulators for Dragon, 18: 24916 (TID-7690(p.189-206))
circulators in Dragon, gas-bearing, 18: 24917 (TID-7690(p.207-18))

HISTIDINE

synthesis and transformation in uv photolysis of organic compounds in mixtures with ammonium compounds, 18: 23204(T) (JPRS-24164 (p.19-42))

HOLMIUM

high-temperature allotropy of, 18: 24176
magnetic properties of, effects of crystalline field and structure on, 18: 24186
polarographic behavior in tetraethylammonium bromide at dropping mercury electrode, 18: 23463
proton elastic scattering at 55 Mev, effects of nuclear deformation on, 18: 24665

HOLMIUM ALLOYS

Ho–Mg, high-temperature allotropy and phase studies on, 18: 24176

HOLMIUM CARBIDES
decomposition pressures and thermodynamic properties, 18: 23440 (CONF-405-38)

HOLMIUM ISOTOPES Ho-149
charge distribution of, from heavy ion reactions with rare earths, 18: 24624 (UCRL-10806)

HOLMIUM ISOTOPES Ho-164
gamma spectra, 18: 24585(R) (IDO-16969)

HOLMIUM ISOTOPES Ho-165
neutron elastic scattering at 0.3 to 14 Mev, spin-spin interactions in, 18: 24645
neutron reactions with oriented, nuclear deformation and spin-spin interaction effects in 350-kev polarized, 18: 24620(R) (ORNL-TM-874)
oxygen-16 scattering at 57 Mev, level excitation in, 18: 24730
proton elastic scattering at 5 and 14 Mev, spin-spin interactions in, 18: 24645
proton scattering at 17.5 Mev, coupled-channel analyses of, 18: 24666

HOLMIUM MANGANATES
magnetic properties and manganese ion moment configurations of, 18: 24128 (CONF-405-34)
magnetic structures, 18: 23523

HOLMIUM OXALATES
dynamic decomposition of, effects of air, carbon dioxide, and nitrogen on, 18: 23507

HOLMIUM OXIDES
magnetic susceptibility at 4.2 to 300°K, 18: 23513
spectra in low frequency region, infrared, 18: 23549
CeO_2–Ho_2O_3, equilibrium phase studies on, 18: 23509

HORMONES
effects of sex, on endogenous respiration of rat testes, 18: 23333
iodine-131-labeled human growth, techniques for producing rapidly, 18: 23225
radiation effects on rat pituitary oxytocin, x, 18: 23275

HOSPITALS
radioactive waste disposal from radiotherapy, 18: 24985

HUMIC ACIDS
$Ca_3(PO_4)_2$–humic acid, separation of radioisotopes from solutions by flocculation of, 18: 24982

HUMIDITY
effects on photographic characteristics of nuclear emulsions, 18: 23922

HYDRACRYLIC ACID, β-LACTONE
radioinduced polymerization, 18: 23604(T,R) (AEC-tr-6316(p.190-4))
radioinduced solid-state polymerization of, effects of second component on, 18: 23605(T,R) (AEC-tr-6316(p.201-7))
radioinduced solid-state polymerization, 18: 23606(T,R) (AEC-tr-6316 (p.208-11))
structure of polymers of, prepared by radioinduced solid-state polymerization, 18: 24148(T,R) (AEC-tr-6316(p.212-16))

HYDRAULICS
perturbation propagation in liquids in serially and parallely connected pump aggregate pipes, 18: 25024(T) (ANL-Trans-24)

HYDRAZOIC ACID
combustion and thermal decomposition processes in, mechanism of, 18: 25027(T) (LA-tr-64-2)

HYDRAZYL, DIPHENYLPICRYL-
electron spin resonance spectra in solvents, effects of degassing on, 18: 23399(T,R) (AEC-tr-6316(p.551-7))

HYDROBROMIC ACID
spectra of deuterated, far-infrared, 18: 23558
spectra of, far-infrared, 18: 23558

HYDROCARBONS
tumorigenic effects in rodents, 18: 23349

HYDROCHLORIC ACID
diffusion into polymers, 18: 25022(T) (ANL-Trans-15)
reactions with tridecylamine, hydrogen bond formation in, 18: 23577
solvent properties for highly radioactive fallout particles, 18: 23795
spectra of deuterated, far-infrared, 18: 23558
spectra of, far-infrared, 18: 23558
thermodynamic properties of deuterium-labeled, in heavy water at 5 to 50°C, 18: 23484
HCl–N, corrosive effects on nickel having weldments, 18: 24813(R) (ANL-6880(p.49-67))
HCl–TBP, solvent properties for californium, europium, fermium, and mendeleevium, 18: 23725

HYDROCINNAMIC ACID, α-METHOXY-
analytical use in determination of zirconium, 18: 23415(T) (JPRS-24552(p.60-1))

HYDRODYNAMICS
difference equations for, two-dimensional, 18: 23771 (UCRL-6776)
uses for analysis of blast waves from underground nuclear explosions, 18: 23783 (NP-13943(p.209-14))

HYDROGEN
determination in liquid sodium, development of methods for, 18: 23411(R) (TID-20614)
deuterium and deuteron reactions at 20 Mev, electron detachment in, 18: 24310
diffusion and precipitation in zirconium, 18: 24131(R) (EURAEC-921)
effects on ductility of high-yield-strength steels, 18: 24153(T,R) (EURAEC-1002)
effects on production of benzene in irradiation of acetylene, 18: 23676
electron densities in plasma of, 18: 24745 (ANL-6802(p.120-5))
electron reactions with ions in plasma of, energy balance and recombination in, 18: 24793
electron reactions with, energy level transitions in, 18: 24314
exchange between heavy and light water and silk fibroin, 18: 23470
exchange with tritium in keratins, 18: 23211
hydrogen ion reactions, formation of H_3^+ in, 18: 24312
meson (π^-) reactions with, gamma angular distributions from, 18: 24417
neutrino reactions in universe, theory of, 18: 24348
neutron elastic scattering by, 18: 24565 (LA-3051)
pickup by Zircaloy-2 in 680°F water and 750°F steam, 18: 24081 (CONF-509-1)
pinch discharge in, spectral line profiles in Z, 18: 24791
plasma of, ionization and recombination in steady-state, 18: 24751 (EUR-CEA-FC-200)
preparation of deuterium enriched, by isotopic exchange between ammonia and hydrogen, 18: 24058(P)
production of highly excited neutral, by charge exchange, 18: 24757 (NP-13948)
production of highly excited neutral, by charge exchange, 18: 24758 (NP-13949)
radioinduced reactions with Teflon, electron spin resonance studies of, 18: 23648(T,R) (AEC-tr-6316(p.534-7))
reactions of, analysis of reduction, 18: 23451 (UCRL-7667)
reactions with helium and hydrogen atoms, short-range, 18: 24313
repulsion of helium atoms by, energy of, 18: 24306
sintering effects on grain size gradient and oxygen/uranium ratio in dioxide pellets, 18: 24109
sorption by molybdenum–rhenium alloys, 18: 24165
spectra of auroral, latitude variations of, 18: 24522
spectra of quasi-molecular, absorption, 18: 24280
use as carrier gas in radon sorption studies on wood charcoal, 18: 23462(T) (SC-T-64-616)
yields in gamma radiolysis of water, mechanism of acidity and solute concentration effects on, 18: 23681

HYDROGEN IONS
hydrated electron reactions with, rate constants for, 18: 23691
injection of high-energy, into mirror machines, 18: 24767(T) (KFK-tr-141)
production of polarized negative, 18: 24680
reactions with atoms and molecules at 10 to 180 kev, dissociation in, 18: 24324
reactions with hydrogen molecules, cross sections for H_3^+ formation in, 18: 24312
reactions with nuclear emulsions, effects of energy and mass on grain darkening in, 18: 23916
sorption on aluminum and nickel surfaces, 18: 23448 (PAN-466/V)

HYDROGEN ISOTOPES
exchange with ammonia, catalysis of, 18: 24058(P)

HYDROGEN ISOTOPES H-4
search for, 18: 24625 (WASH-1046)

HYDROGEN PEROXIDES
hydrated electron reactions with, rate constants for, 18: 23691
production by radiolysis of aqueous sulfuric acid solutions, 18: 23675

- yields in radiolysis of water by proton beams at 1 to 2 Mev, 18: 23578 (LFEN-15)

HYDROGEN SULFIDES
- determination in superheated steam, design of gas chromatograph for, 18: 23407 (DP-880)
- radioinduced addition to 2-butene, isobutene, and propene, 18: 23668
- radioinduced reactions with acrylamide and methacrylamide monomers and polymers, 18: 23650(T,R) (AEC-tr-6316(p.567-72))

HYDROGEN SYSTEMS
- Ar–H, effects on production of benzene in irradiation of acetylene, 18: 23676
- H–O, molecular wave functions of isoelectronic sequence of water, 18: 24296(R) (AD-417517)
- H–O, oxygen vibrational de-excitation in, 18: 24315

HYDROLOGY
- bibliography on tracer methods for, 18: 24044 (NP-13931)
- in arid regions, 18: 23168(R) (STI/DOC/10/25(p.99-111))
- tracer techniques for, development of, 18: 25004(R) (STI/DOC/10/25(p.9-69))

HYDROMAGNETIC WAVES
- production of traveling, coil-system design parameters for, 18: 24754 (NASA-TN-D-2278)

HYDROPEROXIDES
- transient rate constants and spectra of, in oxygenated aqueous solutions, pulse radiolysis studies on, 18: 23678

HYDROXYL IONS
- rotational dynamics of, 18: 24625 (WASH-1046)
- sorption on aluminum and nickel surfaces, 18: 23448 (PAN-466/V)

HYDROXYLAMINES
- benzpylphenyl-, solvent properties for niobium, protactinium, and zirconium, 18: 23728

HYPERFRAGMENTS
- detection in nuclear emulsions, analysis of double-star events, 18: 24445
- hyperon (Λ) binding energies in $_{\Lambda\Lambda}He^{8}$ and $_{\Lambda\Lambda}He^{6}$, 18: 24656
- possible existence of large-strangeness, 18: 24448
- production of nonmesic, 18: 24654

HYPERONS
- resonance states of, radiative decay of Y^*, 18: 24387 (JINR-P-1615)

HYPERONS (Λ)
- binding energies in hyperfragments, 18: 24656
- interactions with hyperons (Λ) with odd Σ-Λ parity, S-wave zero-energy, 18: 24459
- interactions with gamma rays and mesons (η^0), resonance, 18: 24387 (JINR-P-1615)
- production in meson (π) reactions with beryllium-9, cross sections for, 18: 24587 (JINR-P-1584)
- properties in unitary symmetry model, electromagnetic, 18: 24388 (JINR-P-1616)

HYPERONS (Λ^0)
- detection of, electronic system for, 18: 24006
- production in meson (π^-) interactions with carbon nucleons, parity conservation in, 18: 24394 (NEVIS-122)
- production of polarized, in gamma-proton interactions at 950 to 1050 Mev, 18: 24428

HYPERONS (Ω^-)
- discovery, 18: 24396(R) (NP-13947)

HYPERONS (Σ)
- production in meson (π) reactions with beryllium-9, cross sections for, 18: 24587 (JINR-P-1584)

HYPERONS (Σ^-)
- lifetime, 18: 24415

HYPERONS (Σ^0)
- decay of, G_1 symmetry in, 18: 24441
- lifetime of, determination of, 18: 24442
- properties in unitary symmetry model, electromagnetic, 18: 24388 (JINR-P-1616)

HYPERONS (Σ^+)
- decay of, leptonic, 18: 24402 (TID-19033)
- lifetime and mass, 18: 24415
- properties in unitary symmetry model, electromagnetic, 18: 24388 (JINR-P-1616)

HYPERONS (Ξ^-)
- decay rate prediction for, experimental test of nonleptonic, 18: 244
- interactions with protons at low energies, 18: 24460
- mass difference ($\Xi^- - \Xi^0$), 18: 24460
- properties in unitary symmetry model, electromagnetic, 18: 2438 (JINR-P-1616)

HYPERONS (Ξ^0)
- mass difference ($\Xi^- - \Xi^0$), 18: 24460
- properties in unitary symmetry model, electromagnetic, 18: 2438 (JINR-P-1616)

I

ICE
- proton kinetic behavior in, 18: 23466

ICE-*d*₂
- deuteron kinetic behavior in, 18: 23466

IMIDAZOLE-4,5-DICARBOXAMIDE, *N,N'*, 1-TRIMETHYL-
- radiosensitivity effects on neuro-endocrine system in dogs and 18: 23377

IMIDAZOLE-4,5-DICARBOXYLIC ACID
- amide derivatives of, protective effects of, against radiation injuri laboratory animals, 18: 23362(T) (JPRS-24817(p.1-8))

IMMUNE REACTIONS
- primary, in germinal centers of mouse spleen after sheep-red-blood-c stimulation, 18: 24998 (ORNL-3595)

IMMUNITY
- bibliography on, 18: 24998 (ORNL-3595)

IMPACT SHOCK
- properties of, from projectiles striking ground, 18: 25001(R) (SC-DC-64-459)

IN-PILE LOOPS
- operation of pressurized-water, for uranium dioxide fuel testing, 18: 24855(R) (GEAP-3771-12)
- operations of E-SADE, in Vallecitos reactor, 18: 24886(R) (GEAP-4565)
- operations of E-SADE, in Vallecitos reactor, 18: 24884(R) (GEAP-4419)
- power transients in sodium-cooled, containing fuel pins, 18: 238 (ANL-6880(p.72-8))

INCINERATORS
- operation and use for waste processing, 18: 24980(T,R) (EURAEC-

INCONEL
- performance in nuclear-superheater environment, 18: 24886(R) (GEAP-4565)
- performance in nuclear superheater environment, 18: 24884(R) (GEAP-4419)
- performance of 600 and 625, in nuclear superheater environment, 18: 24884(R) (GEAP-4419)
- performance of 625 and 718, in nuclear superheater environment, 18: 24886(R) (GEAP-4565)

INCONEL X
- radiation effects on, gamma and neutron, 18: 24937 (APEX-917)

INDEXES
- to conferences listed in Nuclear Science Abstracts, 1957 through 18: 25005 (TID-4043(Rev.1))

INDIA
- fallout monitoring, 1962 and 1963, 18: 23789 (AEET/AM/39)

INDIAN POINT POWER REACTOR
- startup test results for, 18: 24877 (BAW-189)

INDIUM
- neutron resonance capture by, gamma spectra from, 18: 24625 (WA 1046)
- separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)

INDIUM IODIDES
- electric conductivity in iodoethane, iodomethane, and iodoprop solutions, 18: 23449 (PAN-491/V)

INDIUM ISOTOPES In-113
- neutron capture and inelastic scattering cross sections for, fast 18: 24625 (WASH-1046)

INDIUM ISOTOPES In-115

neutron capture and inelastic scattering cross sections for, fast,
  18: 24625 (WASH-1046)
neutron reactions with, isomeric splitting ratio of first three resonances
  in, 18: 24610 (NP-13930(p.114-15))

INDIUM ISOTOPES In-116

production in neutron irradiation of indium-115, isomeric ratio for,
  18: 24610 (NP-13930(p.114-15))

INDIUM NITRATES

use as thermal neutron monitor, 18: 23896

INDIUM OXIDES

deposition on aluminum, electrolytic, 18: 23537
spectra in low frequency region, infrared, 18: 23549

3-INDOLEACETIC ACID

photolysis in mixtures with ammonium compounds, formation of amino
  acids in uv, 18: 23204(T) (JPRS-24164(p.19-42))

5-INDOLOL, 3-(2-AMINOETHYL)-

radiosensitivity effects on hematopoietic system in rats, 18: 23376

INDUSTRIAL HYGIENE

in plutonium fuel element fabrication facility, 18: 23824 (HW-81363)

INFECTIONS

antibiotic treatment of, in irradiated rabbits, 18: 23315
effect on blood serum protein content on, in irradiated rabbits, 18: 23174
radiation effects on susceptibility to virus, in mice, 18: 23248(T)
  (JPRS-24696)

INFORMATION RETRIEVAL SYSTEMS

development for nuclear physics, 18: 23849

INITIAL ENGINE TEST

radiation effects on components of, gamma and neutron, 18: 24937
  (APEX-917)
testing P-140 mockup, analysis of shock and vibration, 18: 24936
  (APEX-636)

INOR-8

performance in nuclear superheater environment, 18: 24884(R) (GEAP-
  4419)

INSECTS

radiation effects on *Callosobruchus subinnotatus*, gamma, 18: 23270
radiation effects on sterility of cotton moth, gamma, 18: 23283
radioinduced sterility in, effects of air and carbon dioxide on, gamma,
  18: 23276

INSTRUMENTS

bibliography on, 18: 24214 (AED-C-23-01)
description of, for detection of underground formations, 18: 23781
  (NP-13943)
design of nuclear emulsion plate "shuffler", 18: 23847
maintenance of reactor, 18: 24948 (AEET/ROD/6)
sample changer for gamma scintillation well detector, automatic,
  18: 23873 (HW-80798)

INTERFEROMETERS

design for comparison of coherent neutron scattering lengths,
  18: 23878 (NP-13930(p.76-7))
use in plasma spectral line measurements in Z pinch, 18: 24791
use of laser, for plasma diagnostics, 18: 24745 (ANL-6802(p.120-5))

INTERMETALLIC COMPOUNDS

preparation of rare earth–polonium-10, 18: 24127 (CONF-405-33)
superconductivity of metastable, 18: 24142 (TID-20617)

INTERNAL COMBUSTION ENGINES

exhaust gas purification device, 18: 23836(P)

INTESTINE

radiation effects on microstructure of duodenum cells in rats, 18: 23266
radiosensitivity, 18: 23245 (UR-654)

INULIN

radioinduced free radicals in, gamma, 18: 23651(T,R) (AEC-tr-6316
  (p.573-86))

IODIDES

analysis of iodine-131-labeled, for total iodine, 18: 23413 (UR-644)

IODINE

determination of total, in iodine-131-labeled compounds of high specific
  activity, 18: 23413 (UR-644)
effects on radioinduced isomerization of 2-butene, 18: 23666
separation from helium and air-steam mixtures by adsorption on charcoal,
  18: 23386 (CONF-12-3)
sorption by molecular sieves, 18: 23828(R) (UCRL-7637)

IODINE CHLORIDES

reactions with trifluoroethylene, effects of ultraviolet light and metal
  chloride catalysts on, 18: 25016 (UCRL-7373)

IODINE COMPOUNDS

use as fixatives for electron microscopy, 18: 23162(R) (ANL-6823
  (p.174-7))

IODINE ISOTOPES I-125

radioactivity of samples of, methods for assaying, 18: 23390

IODINE ISOTOPES I-131

content in cow's milk, 18: 23829
content in skin and hair, 18: 23207(T) (JPRS-24704(p.6-11))
content in Swedish food, 1962, 18: 23790 (NP-13828)
content of, in milk samples collected in France, 1962 and 1963, effects
  of atmospheric radioactivity and rainfall on, 18: 23819 (CEA-R-2409)
determination by gamma spectroscopy, 18: 23432
determination in VBWR coolant, 18: 24886(R) (GEAP-4565)
distribution in milk products, 18: 23800
distribution in thyroid, technique for measurement of, 18: 23218
incorporation in iodide compounds, method of determining efficiency of,
  18: 23413 (UR-644)
incorporation in rat antibodies and fibrinogen, effects of lysines on
  deposition of, 18: 23219
metabolism, 18: 23816 (AHSB(S) R-64)
retention by sodium reactor coolant, 18: 24816(R) (NAA-SR-8888
  (Sect.IV))
uptake by human growth hormone, technique for rapid, 18: 23225

IODINE ISOTOPES I-132

determination by gamma spectroscopy, 18: 23432
determination in VBWR coolant, 18: 24886(R) (GEAP-4565)

IODINE ISOTOPES I-133

determination in VBWR coolant, 18: 24886(R) (GEAP-4565)

ION BEAMS

neutralization by electron injection in magnetic fields, 18: 24301(T)
  (FTD-TT-64-176)

ION EXCHANGE MATERIALS

development of scintillating, for beta emitters in volume solutions,
  18: 23975
selectivity of calcium, potassium, and sodium zeolites for barium,
  cesium, and sodium, coefficients for, 18: 23480
sorption of radioiodine on molecular sieves, 18: 23828(R) (UCRL-7637)

ION EXCHANGE PROCESSES

use in separation of lanthanides and trivalent actinides, 18: 23699
  (CONF-405-37)

ION SOURCES

design of sputtering, for use in isotope abundance analysis of small
  solid samples, 18: 23406 (CONF-512-4)
development for space vehicle propulsion, 18: 23740(R) (NP-13899)
performance of perforated, in propulsion systems, 18: 24366 (ASD-
  TDR-63-750)
uses of duoplasmatron, in neutron generator, 18: 24247 (NP-13930
  (p.140))

IONIZATION

theory of, by electron collision, 18: 24308

IONIZATION CHAMBERS

alpha collimators for, 18: 24007
design of neutron-sensitive, for flux plotting in reactors, 18: 24039(P)
design of, with sub-nsec rise time, 18: 24813(R) (ANL-6880(p.49-67))
radiation effects on, neutron, 18: 23888 (PWAC-424)
response in pulsed beams, 18: 23897

IONOSPHERE

blackouts and magnetic activity in Southern Hemisphere during IGY, spiral
  distributions of, 18: 24525
disturbances in, correlation of geomagnetic storms and, 18: 24534
disturbances in, diurnal variations of, 18: 24524
ionization density increase in E region, effects on solar quiet-day varia-
  tion of geomagnetic field, 18: 24527
ionization irregularities in equatorial electrojet, theory of, 18: 24539
lunar tidal oscillations in E layer of, 18: 24533
magnetic disturbances at conjugate points in, from solar corpuscular radi-
  ation, 18: 24526
plasma diffusion in, ambipolar, 18: 24781
plasma instabilities in, 18: 24780

properties of, review of, 18: 24517
radio propagation in, effects of atomic explosions on v-l-f, 18: 24540
solar flare effects on E and D layers of, 18: 24283
variations of equatorial spread-F, 18: 24535
variations of equatorial sporadic E, 18: 24541
IONS
detection and discrimination of heavy, in nuclear emulsions, 18: 23954
electron reactions in metals, theory of, 18: 24170
electron reactions in superconductors, theory of, 18: 24555
electron reactions in plasma, bremsstrahlung emission from, 18: 24792
electron reactions with plasma, energy balance and recombination in, 18: 24793
electron reactions with plasma, energy balance and recombination in, 18: 24794
electron reactions with plasma, recombination coefficient for, 18: 24801
interactions with atoms at low energies, cross sections for charge-exchange, 18: 24321
kinetic energy of, in mass spectra of organic compounds, 18: 25019 (UCRL-10823)
motion in exosphere, wave amplification from cyclotron instability in, 18: 24790
motion in liquid-helium plasma, 18: 24739(R) (AD-417496)
reactions with rare earths, effective charge distribution from, 18: 24624 (UCRL-10806)
relaxation in plasma, theory for, 18: 24760 (NP-13951)
IRIDIUM
neutron capture gamma spectra, 18: 24625 (WASH-1046)
IRIDIUM ALLOYS
Ir–Nb, electric and mechanical properties, 18: 24158
Ir–Pt, performance as electrodes in ion engines in spacecraft, 18: 23740(R) (NP-13899)
IRIDIUM COMPOUNDS
use as fixatives for electron microscopy, 18: 23162(R) (ANL-6823 (p.174-7))
IRON
coating effects on electric contact resistance, 18: 24357 (ANL-6802 (p.78-86))
determination in highly radioactive fallout particles, x-ray microscopic, 18: 23794
effects on beryllium crystals, 18: 24066(R) (NMI-2126)
effects on beryllium crystals, 18: 24067(R) (NMI-2127)
effects on mechanical properties of beryllium crystals, 18: 24134(R) (NMI-1257)
electron backscattering at 4 to 14 Mev, 18: 24409
gamma scattering at 280 kev, small-angle, 18: 24412
neutron beam passage through magnetized, depolarization in, 18: 24568 (NP-13930(p.78-9))
neutron capture by, use of lead spectrometer for studying, 18: 24608 (NP-13930(p.110-11))
neutron capture gamma spectra, 18: 24625 (WASH-1046)
neutron inelastic scattering by, polarization in, 18: 24625 (WASH-1046)
neutron inelastic scattering at 2 to 5 Mev, 18: 24625 (WASH-1046)
neutron total cross section of, 18: 24625 (WASH-1046)
polishing by electrolytic methods, 18: 24107(T) (SC-T-64-903)
separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)
sorption and exchange in peat, 18: 23806
sorption of americium-241 and protactinium-233 by, from water–ethanol solutions, 18: 23724
stresses in, at low temperatures, effects of twinning on yield, 18: 24129 (CONF-524-5)
IRON ALLOYS
radiation effects on mechanical properties and microstructure of, at 50 to 650°C, 18: 24193 (HW-SA-3436)
Al–Fe, electric conductivity at high temperatures, 18: 23837 (CEA-R-2402)
Al–Fe–U, phase studies, 18: 24135(R) (NMI-2812)
Al–Fe–U, radiation induced growth in, 18: 24204
Au–Fe, ferromagnetism at low temperatures in dilute, 18: 24143 (UCRL-7390)
Cr–Cu–Fe–Mo–Ni, performance of Ni–O–Nel 825 in nuclear superheater environment, 18: 24886(R) (GEAP-4565)
Cr–Fe–Ni, performance of Incoloy, Incoloy 800, Incoloy 801, and Ni–O–Nel in nuclear superheater environment, 18: 24886(R) (GEAP-4565)
Cr–Fe–Ni, performance of Incoloy, Incoloy 800, Ni–O–Nel, and RA 330 in nuclear superheater environment, 18: 24884(R) (GEAP-4419)
Fe–Mo, vacancy formation in, 18: 24160
Fe,Nd, neutron diffraction study of magnetic behavior and structure, 18: 24184
Fe–Ni, effects of alloying on strength of, 18: 24161
Fe–Ni, physical properties of, effects of molybdenum admixtures on, 18: 24159
Fe,Pr, neutron diffraction study of magnetic behavior and structure, 18: 24184
Fe–Pu, viscosities of, 18: 24815(R) (MLM-1184)
Fe–Pu–U, performance as zero-power reactor fuel, 18: 24952(R) (ANL-6880(p.6-48))
Fe–Rb, magnetic transformations in, neutron diffraction study of, 18: 24166
Fe–Rh, magnetic moments and unpaired spin densities in, 18: 24169
Fe–Ti, bulk superconductivity in, 18: 24553
Fe–U, phase studies, 18: 24135(R) (NMI-2812)
IRON CHLORIDES
catalytic effects on reactions of iodine chloride with trifluoroethylene, 18: 25016 (UCRL-7373)
IRON(III) HYDROXIDES
decontamination of radioactive waste water by flocculation of, 18: 24981
IRON IONS
radiolysis effects on aqueous sulfuric acid solutions, 18: 23675
IRON ISOTOPES Fe-53
gamma spectra, 18: 24585(R) (IDO-16969)
IRON ISOTOPES Fe-54
deuteron reactions (d,p) with, angular distribution from, 18: 24625 (WASH-1046)
IRON ISOTOPES Fe-56
neutron capture and transmission of 10 to 80 kev, resonance, 18: 24620(R) (ORNL-TM-874)
neutron elastic and inelastic scattering at 1 and 2.2 Mev polarization in, 18: 24694
neutron reactions (n,n′γ) with, 18: 24625 (WASH-1046)
neutron transmission by, resonances in, 18: 24625 (WASH-1046)
proton inelastic scattering by, resonances in, 18: 24625 (WASH-1046)
IRON ISOTOPES Fe-57
neutron capture cross sections, 18: 24620(R) (ORNL-TM-874)
IRON ISOTOPES Fe-59
uptake by rat erythrocytes, 18: 23296
IRON OXIDES
deposition on aluminum, electrolytic, 18: 23537
spectra in low frequency region, infrared, 18: 23549
IRON(III) OXIDES
catalytic effects on radioinduced isomerization of 2-butene, 18: 23667
effects on radiation behavior of polymers, 18: 24199(T,R) (AEC-tr-6316 (p.359-67))
IRON SILICIDES
iron magnetic moment in, 18: 24164
IRON SULFATES
reactions of ferrous–ferric, in nuclear emulsion, 18: 23550
IRON(II) SULFATES
radioinduced oxidation in, pulsed electron, 18: 23692
IRON SYSTEMS
B–Fe, radiation effects on stainless steel-clad, 18: 24195 (ORNL-TM-815)
IRRADIATION FACILITIES
gamma dose and neutron flux measurements at TRIGA F reactor, 18: 24957 (NDL-TR-59)
IRRADIATION TECHNIQUES
for applying radiocured polymer coatings to surfaces, 18: 23400(P)
ISOBUTYLAMINE
dissociation by electron bombardment, mass spectra from, 18: 23608(T,R) (AEC-tr-6316(p.232-7))
ISOBUTYRIC ACID
photolysis in mixture with ammonium nitrate, formation of amino acids in

ev, 18: 23204(T) (JPRS-24164(p.19-42))

ISOBUTYRONITRILE

radioinduced polymerization, 18: 23596(T,R) (AEC-tr-6316(p.152-3))

ISOMERIC TRANSITION

measurement of lifetimes using semiconductor detectors, 18: 24025

ISOPROPYLAMINE

dissociation by electron bombardment, mass spectra from, 18: 23608(T,R) (AEC-tr-6316(p.232-7))

radioinduced polymerization at low temperatures, 18: 23591(T,R) (AEC-tr-6316(p.129-30))

ISOTOPE EFFECTS

on hydrogen bonds in trioctylamine compounds with nitric acid, 18: 23576

on physical properties of wheat gluten due to hydrogen bonding, 18: 23477

on thermal expansion of lithium at 4.2 to 300°K, 18: 23450 (TID-20252)

ISOTOPE SEPARATION METHODS

exchange, catalysis in dual-temperature hydrogen, 18: 24058(P)

thermal-diffusion, summary, 18: 24050(R) (ORNL-3607)

ISOTOPES

separation factor occurring in the chromatography of dual-labeled compounds, calculation of, 18: 23194(R) (ANL-6823(p.141-51))

ISOTOPIC EXCHANGE

between carbon dioxide and its ethanolamine solutions, 18: 24052(T) (ORNL-tr-68)

J

JAPAN

fallout monitoring in Osaka Prefecture, 1963, 18: 23793

JOINTS

design of expansion, for pressurized-fluid circuits, 18: 24835(P)

JOURNAL BEARINGS

pressure distribution in gas-lubricated tilting-pad, 18: 23747 (TID-7690(p.273-302))

K

KAOLINITES

radiation effects on, electron and gamma, 18: 23171

KERATINS

hydrogen–tritium exchange in, 18: 23211

KETENE

diketene, radioinduced polymerization with β-propiolactone, 18: 23605(T,R) (AEC-tr-6316(p.201-7))

diketene, radioinduced solid-state polymerization, 18: 23606(T,R) (AEC-tr-6316(p.208-11))

radioinduced polymerization of, gamma, 18: 23603(T,R) (AEC-tr-6316 (p.186-9))

radioinduced polymerization with β-propiolactone, 18: 23604(T,R) (AEC-tr-6316(p.190-4))

KETENE POLYMERS

structure of, prepared by radioinduced solid-state polymerization, 18: 24148(T,R) (AEC-tr-6316(p.212-16))

KETONES

labeling of Artemisia, with tritium, 18: 23564

KIDNEYS

effects of uranyl nitrate enzyme activity in mouse, 18: 23213

function of, in rats, effects of niobium poisoning on, 18: 23203 (UR-646)

lesions of renal tubes induced by uranyl nitrate in mouse, 18: 23214

radiation effects on function in mouse, x, 18: 23291

renograms of, clinical application and evaluation of, 18: 23393

KILNS

design and operation of pot and spray calciners for processing wastes, 18: 24975(R) (HW-81829)

KRYPTON

diffusion in tantalum electrodes under glow discharge, 18: 24065(R) (GEMP-34A)

electric discharge in, microwave resonance emission spectra of, 18: 24772

sorption by molybdenum disulfide, determination of specific surface from, 18: 23696

KRYPTON IONS

reactions with nuclear emulsions, effects of energy and mass on grain darkening in, 18: 23916

KRYPTON ISOTOPES

content in air and water of swimming pool reactor, 18: 24947 (AEET/AM/38)

separation by thermal diffusion, 18: 24050(R) (ORNL-3607)

KRYPTON ISOTOPES Kr-85

release from irradiated uranium carbides at 1000 to 1600°C, 18: 24988(R) (BMI-1665(Del.))

release from irradiated coated fuel particles, 18: 24988(R) (BMI-1665(Del.))

KRYPTON ISOTOPES Kr-87

release from irradiated coated fuel particles, 18: 24988(R) (BMI-1665(Del.))

KRYPTON ISOTOPES Kr-88

release from irradiated coated fuel particles, 18: 24988(R) (BMI-1665(Del.))

L

LA CROSSE BOILING WATER REACTOR

design and development, quarterly summary No. 3, 18: 24874(R) (ACNP-64529)

LABORATORY EQUIPMENT

design of portable shower cabinet, 18: 23808 (AERE-R-4084)

LACTOSE

radioinduced free radicals in, gamma, 18: 23651(T,R) (AEC-tr-6316 (p.573-86))

LAMINATES

charged-particle energy straggling in, 18: 24297 (AFCRL-63-558)

electromagnetic wave propagation in, 18: 24808

LANTHANUM

magnetic properties of, effects of crystalline field and structure on, 18: 24186

polarographic behavior in tetraethylammonium bromide at dropping mercury electrode, 18: 23463

separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)

LANTHANUM ALLOYS

La–Nb, electric and mechanical properties, 18: 24158

LANTHANUM CHLORIDES

solubility of gypsum in aqueous solutions of, 18: 23536

LANTHANUM COMPLEXES

with EDTA, stereochemistry of, 18: 23518

LANTHANUM ISOTOPES La-138

neutron resonances at 20 to 400 ev, 18: 24620(R) (ORNL-TM-874)

LANTHANUM ISOTOPES La-139

proton elastic scattering at 55 Mev, effects of nuclear deformation on, 18: 24665

LANTHANUM ISOTOPES La-140

production in neon-22 and oxygen-18 reactions with thorium-232, 18: 24690

LANTHANUM ISOTOPES La-141

production in neon-22 and oxygen-18 reactions with thorium-232, 18: 24690

LANTHANUM NITRATES

solubility in tributyl phosphate at 25°C, 18: 23712

LANTHANUM OXALATES

dynamic decomposition of, effects of air, carbon dioxide, and nitrogen on, 18: 23507

LANTHANUM OXIDES

deposition on aluminum, electrolytic, 18: 23537

spectra in low frequency region, infrared, 18: 23549

CeO_2–La_2O_3, equilibrium phase studies on, 18: 23509

La_2O_3–ZrO_2, crystal structure, differential thermal analysis, and thermal expansion of, 18: 23503

LANTHANUM SYSTEMS

La–Te, crystal chemistry and phase studies of, 18: 23506

LANTHANUM THIOSULFATES

dissociation in water, constants and spectra of, 18: 23501

LEAD

electron backscattering at 4 to 14 Mev, 18: 24409

energy levels in, collective, 18: 24625 (WASH-1046)
gamma scattering at 280 kev, small-angle, 18: 24412
neutron reactions with, neutron yield in, 18: 24625 (WASH-1046)

LEAD ALLOYS
Bi–Pb, use as shielding-coolant in apparatus for transport of radioactive materials, 18: 23759(P)
Pb–Li, performance in fuel cells, 18: 24355 (ANL-6802(p.53-63))

LEAD CHLORIDES
reactions with strontium-90 and alkali metal chlorides to form complex crystals, 18: 23540

LEAD COUPLES
Al/Pb–Tl, surface superconductivity in, 18: 24548

LEAD ISOTOPES
neutron capture, 18: 24625 (WASH-1046)
neutron resonances at 1.68 to 28 kev, parameters for, 18: 24620(R) (ORNL-TM-874)

LEAD ISOTOPES Pb-202
decay of, semiconductor detection of, 18: 23990

LEAD ISOTOPES Pb-204
neutron reactions (n,2n) with, cross section for, 18: 24625 (WASH-1046)

LEAD ISOTOPES Pb-206
neutron capture and transmission at 10 to 80 kev, resonance, 18: 24620(R) (ORNL-TM-874)

LEAD ISOTOPES Pb-207
meson (π^-) reaction, cross sections of particle production in, 18: 24587 (JINR-P-1584)
neutron capture and transmission at 10 to 80 kev, resonance, 18: 24620(R) (ORNL-TM-874)
neutron transmission by, resonances in, 18: 24625 (WASH-1046)

LEAD ISOTOPES Pb-208
ion inelastic scattering at 125 and 166 Mev, excitation in, 18: 24708
neutron capture and transmission at 10 to 80 kev, resonance, 18: 24620(R) (ORNL-TM-874)
neutron transmission by, resonances in, 18: 24625 (WASH-1046)

LEAD OXIDES
deposition on aluminum, electrolytic, 18: 23537
effects on radiation behavior of polymers, 18: 24199(T,R) (AEC-tr-6316 (p.359-67))
spectra in low frequency region, infrared, 18: 23549

LEAD TELLURIDES
electric conductivity of iron plated contacts of, 18: 24357 (ANL-6802 (p.78-86))

LECTURES
on elementary particles, 18: 24482
on theory of nuclear matter, 18: 24593 (NP-13925)

LEPTONS
emission in hyperon ($\Sigma^{\pm}$) decay, 18: 24402 (TID-19033)
emission in meson ($W^{\pm}$) decay, 18: 24464
interactions in Feinberg-Pais peratization theory, chain approximation for, 18: 24407
interactions with nucleons, scattering amplitudes for, 18: 24419

LEUCINE
photolysis of, transformation of amino acids in uv, 18: 23204(T) (JPRS-24164(p.19-42))
synthesis and transformation in uv photolysis of organic compounds in mixtures with ammonium compounds, 18: 23204(T) (JPRS-24164 (p.19-42))
synthesis and transformation in uv photolysis of organic compounds in mixtures with ammonium compounds, 18: 23204(T) (JPRS-24164 (p.19-42))

LEUKEMIA
radioinduced in mice, plasma lactic dehydrogenase activity in, 18: 23256

LEUKOCYTES
radiation effects on metabolic and phagocytic activities of polymorphonuclear, in guinea pigs, 18: 23242(R) (TID-20379)
radiation effects on human, x, 18: 23294

LEUKOPENIA
radioinduced in rabbits, protective effects of theophylline and nucleic acids against, 18: 23373

LEVEL INDICATORS
design of radiometric, 18: 24048(P)

LIBRARIES
graphs of Aldermaston and Winfrith nuclear data, computer program for producing, 18: 24987 (AEEW-M-426)

LIFE SPANS
dietary effects of cesium-137 and strontium-90 on mouse, 18: 23210
radiation effects on mouse, gamma and neutron, 18: 23230(R) (ANL-6823(p.15-19))
radiation effects on rat, effects of age at irradiation on, fast neutron, 18: 23292
radiation effects on mice, factors affecting, x, 18: 23347

LIGHT
detection and measurement by nuclear emulsion, 18: 23910
gynogenetic effects in vertebrates, 18: 23335
propagation of, cosmological model of, 18: 24543
propagation through isotropic medium, nonlinear theory for, 18: 24215 (RM-4093-PR)
reactions with silver nitrates, decomposition in, 18: 23687
scattering by light in plasma, 18: 24788

LIGHT SOURCES
for producing retinal burns, 18: 23254

LIGURIAN SEA
composition of water and marine organisms in, 18: 23167(R) (STI/DOC/10/25(p.71-98))
fallout monitoring, 1963, 18: 23167(R) (STI/DOC/10/25(p.71-98))

LINEAR ACCELERATORS
beam pulse production in, equipment and method for short, 18: 24254
design and construction of 2-Bev, 18: 24248 (NP-13960)
design and performance of 90 Mev, 18: 24245 (NP-13914)
design of efficient high-energy pulsed, 18: 24268(P)
deuteron and proton acceleration in CERN, comparison of, 18: 24241 (CERN-64-22)
plasma acceleration in, 18: 24775
use for efficiency studies on secondary electron monitor at 15 Mev, 18: 24253

LIPIDS
radiation effects on synthesis of, 18: 23301
radiation effects on plasma content of, 18: 23302

LIQUID FLOW
heat transfer in one-phase, near critical point, 18: 24813(R) (ANL-6880(p.49-67))

LIQUID METAL COOLED REACTORS
coolant void reactivity coefficient of sodium in, 18: 24813(R) (ANL-6880(p.49-67))
development of ASCR, 18: 24891(R) (NAA-SR-8888(Sect.I))
fuel development for fast, 18: 24952(R) (ANL-6880(p.6-48))

LIQUIDS
bubble growth in, with initially uniform superheat, 18: 23774
radioactivity of substances in, measurement method for, 18: 24041(P)
separation in gravity settler, effects of induced coalescence on, 18: 23708 (UCRL-11182)
settling of, mechanism of, 18: 23452 (UCRL-10625)
triplet distributions in, superposition approximation for, 18: 24311
virial functions and potential for, intermolecular, 18: 23560

LITHIUM
corrosive effects on Haynes 25 Alloy and type 316 stainless steel at 1600°F, 18: 24085(R) (NASA-CR-54053)
determination by activation analysis, 18: 23427
plasma of, ionization and recombination in steady-state, 18: 24751 (EUR-CEA-FC-200)
production of plasma of, 18: 24750 (EUR-1627.f)
sorption by phosphoric acid resins, effects of acidity on selectivity coefficients for, 18: 23481
thermal expansion of isotopically enriched, at 4.2 to 300°K, 18: 23459 (TID-20252)

LITHIUM ACETATES
performance of nuclear emulsions loaded with, 18: 23919

LITHIUM ALLOYS
Bi–Li, performance in fuel cells, 18: 24355 (ANL-6802(p.53-63))
Cd–Li, performance in fuel cells, 18: 24355 (ANL-6802(p.53-63))
Li–Sn, performance in fuel cells, 18: 24355 (ANL-6802(p.53-63))
Li–Zn, performance in fuel cells, 18: 24355 (ANL-6802(p.53-63))
Pb–Li, performance in fuel cells, 18: 24355 (ANL-6802(p.53-63))

LITHIUM CHLORIDES

electric conductivity of melts, temperature coefficients for, 18: 23456(T) (Al-Trans-46)
probe relaxation times in aqueous solutions of, 18: 23559
LiCl–LiH, corrosive effects on type 316 stainless steel at 1600°F, 18: 24085(R) (NASA-CR-54053)
LiCl–MgCl$_2$–NaCl, phase studies on, 18: 24813(R) (ANL-6880 (p.49-67))
LiCl–MgCl$_2$–KCl, phase studies on, 18: 24813(R) (ANL-6880(p.49-67))

LITHIUM COMPOUNDS
crystal structure of ferroelectric hydrazinium sulfate, 18: 24989 (BNL-7034)

LITHIUM COOLED REACTOR EXPERIMENT
control drum drive for, 18: 24908 (PWAC-412)
design, 18: 24909 (PWAC-416)
fission counter amplifiers for, 18: 24822 (PWAC-427)
instrument testing, 18: 23888 (PWAC-424)

LITHIUM FLUORIDES
heat of solution of, calculation of, 18: 23515
thermoluminescence of doped, effects of magnesium on, 18: 23828(R) (UCRL-7637)
LiF–LiH, corrosive effects on type 316 stainless steel at 1450 to 1600°F, 18: 24085(R) (NASA-CR-54053)

LITHIUM HYDRIDES
corrosive effects on Haynes 25 Alloy and type 316 stainless steel at 1000 to 1650°F, 18: 24085(R) (NASA-CR-54053)
performance in fuel cells, 18: 24355 (ANL-6802(p.53-63))
radiation effects on physical properties of, at 2×10^{18} nvt and 1000°F, 18: 24188 (APEX-329)
LiCl–LiH, corrosive effects on type 316 stainless steel at 1600°F, 18: 24085(R) (NASA-CR-54053)
LiF–LiH, corrosive effects on type 316 stainless steel at 1450 to 1600°F, 18: 24085(R) (NASA-CR-54053)

LITHIUM IONS
entropy of aqueous, calculation of standard, 18: 23515

LITHIUM ISOTOPES Li-6
electron inelastic scattering at 40 to 70 Mev, M1 transitions following, 18: 24675
electron inelastic scattering at 40 to 70 Mev, M1 transitions following, 18: 24676
emission in boron-10 reactions with light nuclei at 105.5 Mev, spectra of, 18: 24723
emission in deuteron reactions (d,Li-6) with nuclei at 15 Mev, angular distributions for, 18: 24714
gamma reactions (y,p) at 5.7 to 20 Mev, angular and energy distributions from, 18: 24695
gamma reactions at 5.7 to 19 Mev, cross sections for, 18: 24695
ion reactions at 6.2 and 9.6 Mev, gamma spectra of, 18: 24721
lithium reactions at 3 Mev, analysis of, 18: 24722
mobility of ionic, in aqueous solutions of potassium nitrate at 25°C, 18: 23467
reactions with boron-10 and -11 at 3.5 to 4.5 Mev, angular distributions for, 18: 24720
reactions with light nuclei at 36 and 63 Mev, dissociation in, 18: 24723
reactions with nuclei at 3 Mev, analysis of, 18: 24722
use in neutron detector semiconductor telescope, 18: 23986

LITHIUM ISOTOPES Li-7
emission in boron-11 reactions with light nuclei at 115.5 Mev, spectra of, 18: 24723
emission in deuteron reactions (d,Li-7) with nuclei at 15 Mev, angular distributions for, 18: 24714
ion reactions at 6.2 and 9.6 Mev, gamma spectra of, 18: 24721
lithium reactions at 3 Mev, analysis of, 18: 24722
lithium-7 elastic scattering at 7.3 Mev, differential cross sections for, 18: 24325
mobility of ionic, in aqueous solutions of potassium nitrate at 25°C, 18: 23467
reactions with boron-10 and -11 at 3.5 to 4.5 Mev, angular distributions for, 18: 24720
reactions with light nuclei at 73.5 Mev, dissociation in, 18: 24723
reactions with nuclei at 3 Mev, analysis of, 18: 24722
scattering by carbon-12 at 7.3 Mev, differential cross sections for, 18: 24325

LITHIUM MOLYBDATES
Li$_2$MoO$_4$–MoO$_3$, temperature effects on density and electric conductivity of, 18: 23486

LITHIUM SYSTEMS
Li–Te, performance in fuel cells, 18: 24355 (ANL-6802(p.53-63))

LITHIUM URANYL PHOSPHATES
solubility of, tracer studies of, 18: 23545

LITTER SIZES
dietary effects of cesium-137 and strontium-90 on mouse, 18: 23210

LIVER
activation and inactivation of p-hydroxyphenylpyruvic acid oxidase in, of guinea pigs, 18: 25009 (TID-19079)
plutonium uptake by mouse, protective effects of diethylenetriaminepentaacetic acid against, 18: 23350(R) (ANL-6823(p.105-8))
plutonium-239 removal from mouse, using calcium salt and pentaethyl ester of carboxymethyliminobis(ethylenenitrilo)tetraacetic acid, 18: 23369
radiation effects on oxidative phosphorylation in mitochondria of rat, x, 18: 23233(R) (ANL-6823(p.157-60))
radiation effects on enzyme activity in rat, 18: 23241(R) (NP-13918 (p.13-27))
radiation effects on mercamine metabolism in, 18: 23304
radiation effects on peripheral nerve structure in dog and rabbit, 18: 23309
radiosensitivity of enzyme systems in rat, effects of steroids on, 18: 23352(R) (NP-13918(p.28-41))
soluble nuclear proteins in rat, factors affecting, 18: 23192(R) (ANL-6823(p.124-7))

LIVERMORE POOL TYPE REACTOR
radiation hazards from water loss from, 18: 23828(R) (UCRL-7637)

LOS ALAMOS TURRET REACTOR
construction and testing of, summary, 18: 24889(R) (LAMS-3069)

LUBRICANTS
radiation effects on, gamma and neutron, 18: 24937 (APEX-917)

LUMINESCENCE
decay-time constants for scintillators using single-photoelectron technique, 18: 23977

LUTETIUM
high-temperature allotropy of, 18: 24176
polarographic behavior in tetraethylammonium bromide at dropping mercury electrode, 18: 23463

LUTETIUM ALLOYS
Lu–Mg, high-temperature allotropy and phase studies on, 18: 24176

LUTETIUM ISOTOPES Lu-176
neutron resonance integrals for, 18: 24625 (WASH-1046)

LUTETIUM MANGANATES
magnetic properties and manganese ion moment configurations of, 18: 24128 (CONF-405-34)
magnetic structures, 18: 23523

LUTETIUM OXIDES
spectra in low frequency region, infrared, 18: 23549

LYMPH CELLS
effects of injections of homologous, on wound healing in irradiated mice, 18: 23273

LYMPH SYSTEM
primary immune response of, in mice, 18: 24998 (ORNL-3595)

LYSINES
effects on radioiodinated antibody and fibrinogen deposition in rats, 18: 23219
photolysis of, transformation of amino acids in uv, 18: 23204(T) (JPRS-24164(p.19-42))
synthesis and transformation in uv photolysis of organic compounds in mixtures with ammonium compounds, 18: 23204(T) (JPRS-24164 (p.19-42))

M

MAGNESIUM
abundance variations in A, Ap, and B stars, 18: 24274
crystal lattice vibrational spectra, 18: 24168
determination in biological materials, activation, 18: 23418
effects on thermoluminescence of doped lithium fluorides, 18: 23828(R)

(UCRL-7637)
separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)
sorption and exchange in peat, 18: 23806

MAGNESIUM ALLOYS
Cd–Mg–Zn, solvent properties for praseodymium, 18: 24952(R) (ANL-6880(p.6-48))
Dy–Mg, high-temperature allotropy and phase studies on, 18: 24176
Er–Mg, high-temperature allotropy and phase studies on, 18: 24176
Gd–Mg, high-temperature allotropy and phase studies on, 18: 24176
Ho–Mg, high-temperature allotropy and phase studies on, 18: 24176
Lu–Mg, high-temperature allotropy and phase studies on, 18: 24176
Mg–Ag, performance as dynodes, effects of cesium on, 18: 23865
Mg–Tb, high-temperature allotropy and phase studies on, 18: 24176
Mg–Tm, high-temperature allotropy and phase studies on, 18: 24176

MAGNESIUM CHLORIDES
electric conductivity of melts, temperature coefficients for, 18: 23456(T) (AI-Trans-46)
LiCl–MgCl$_2$–NaCl, phase studies on, 18: 24813(R) (ANL-6880 (p.49-67))
LiCl–MgCl$_2$–KCl, phase studies on, 18: 24813(R) (ANL-6880(p.49-67))
MgCl$_2$–KCl–NaCl, solvent properties for praseodymium, 18: 24952(R) (ANL-6880(p.6-48))

MAGNESIUM ISOTOPES Mg-24
alpha capture and scattering by, 18: 24625 (WASH-1046)
alpha scattering cross sections at 18 to 21 Mev, 18: 24620(R) (ORNL-TM-874)
deuteron reactions (d,p) at 10.1 Mev, finite range effects in, 18: 24686
electron inelastic scattering at 40 to 70 Mev, M1 transitions following, 18: 24675
neutron elastic and inelastic scattering at 2.8 Mev, polarization in, 18: 24694

MAGNESIUM ISOTOPES Mg-25
triton reactions (t,α) with, 18: 24625 (WASH-1046)

MAGNESIUM ISOTOPES Mg-26
triton reactions (t,p) with, 18: 24625 (WASH-1046)

MAGNESIUM LANTHANUM NITRATES
proton polarization in single crystals of, effects of neodymium-142 on, 18: 23444 (JINR-P-1626)

MAGNESIUM OXIDES
catalytic effects on radioinduced isomerization of 2-butene, 18: 23667
dissociation energy of, mass spectrometric determination of, 18: 23455 (WADD-TR-60-782(Pt.XXII))
spectra in low frequency region, infrared, 18: 23549
spectra of, vibrational analysis of, 18: 24316
MgO–Sc$_2$O$_3$, phase studies on, 18: 23529

MAGNESIUM SILICATES
sorptive properties for organic compounds, 18: 25032(T) (SC-T-64-618)

MAGNESIUM SULFATES
as catalyst in dehydration of cyclohexanol, effects of alpha particles from protactinium-231 on, 18: 23672
crystal structure and hydrogen bonding of hexahydrate, 18: 25020 (UCRL-10832)

MAGNETIC FIELDS
charged particle focusing in crossed electric and, 18: 24262
effects on superconding rod with anchored filament structure, 18: 24552
electron beam motion in perturbed, in betatrons, 18: 24256
electron translation in, Bloch, 18: 24504
electron translation in, irreducible representations for Bloch, 18: 24505
interactions with plasma, review on, 18: 24746 (ARL-64-34)
interplanetary, cosmic-ray determination of, 18: 24330
ion beam neutralization by electron injection in, 18: 24301(T) (FTD-TT-64-176)
penetration in plasma, skin effect in, 18: 24800
photon reactions with interstellar, Doppler shift from, 18: 24289
plasma containment by, plasma duplexer performance with, 18: 24740(R) (AD-426769)
plasma containment in, configurations for, 18: 24755 (NP-13895)
plasma cyclotron instability in, wave amplification from, 18: 24790
plasma oscillations in, stability of, 18: 24787
production for plasma containment and heating, 18: 24804(P)
uses with nuclear emulsions, for track analysis, 18: 23946

MAGNETIC MIRROR MACHINES
development, 18: 24763(R) (UCRL-11172)
electron trapping in French CAPEL, 18: 24747 (CEA-R-2417)
injection method for, 18: 24767(T) (KFK-tr-141)

MAGNETIC MIRRORS
electron trapping at 1.8 kev by periodic electrostatic perturbations, 18: 24747 (CEA-R-2417)

MAGNETIC PROPERTIES
bibliography on rare earth, 18: 24178

MAGNETIC RECORDING SYSTEMS
development of thin-film fast magnetic memories, 18: 23862
performance of magnetic-tape multidimensional analyzers using recording check and memory check, 18: 24012
tape recording and reading unit with parity detection for, 18: 23853
tape recording at random time intervals, transistorized buffer memory for regularization of data flow for, 18: 23854
use of closed-loop system for recording events with erratic time distribution, 18: 24001
use of ferrite core matrix for scattering experiment in sonic spark chamber, 18: 24000
use of intermediate memory in analyzers under pulse conditions, 18: 24011

MAGNETIC RESONANCE
electron spin spectra of irradiated polymers, output saturation in, 18: 23617(T,R) (AEC-tr-6316(p.310-13))
radiation effects on protein, gamma, 18: 23289
saturation effects in electron spin spectra of free radicals in irradiated polymers, 18: 24220(T,R) (AEC-tr-6316(p.603-8))

MAGNETOHYDRODYNAMIC CELLS
design of acoustically resonant Stirling engine for, 18: 24364 (ANL-6802(p.166-9))
development, 18: 24374
development for use as electric power sources, 18: 24375
development of, review of, 18: 24359 (ANL-6802(p.101-9))
energy sources for, parameters of explosive, 18: 24365(R) (ASD-TDR-63-37)

MAGNETOHYDRODYNAMICS
channel flow of electrically conducting fluid, 18: 23777
equations for, in anisotropic media, 18: 24768
flow of thermally-conducting gas, reciprocal relations for rotational, 18: 23778
flow through cylindrical channel, electrical effects of, 18: 23773
plasma flow in cylinders, analysis of, 18: 24769
relativistic, interpretation of shock relations in, 18: 24227
structure of slow shock in two-fluid system with dissipation, 18: 2422
thermonuclear uses, 18: 24763(R) (UCRL-11172)

MAGNETOMETERS
design of nuclear induction, for weak fields, 18: 23869(P)

MAGNETOSPHERE
boundary of, observations on, 18: 24749 (CONF-521-2)

MAGNETS
design of superconducting, 18: 24547
potential measurements of aluminum, at cryogenic temperatures, 18: 24544(R) (NBS-8253)
use of superconducting, in ESR studies, 18: 23524

MAIZE
fallout monitoring in Swedish, 1962, 18: 23790 (NP-13828)

MALTOSE
radioinduced free radicals in, gamma, 18: 23651(T,R) (AEC-tr-6316 (p.573-86))

MAN
calcium-47 uptake by, liquid scintillation measurement of, 18: 23226
iodine-131 content in skin and hair of, 18: 23207(T) (JPRS-24704 (p.6-11))
iodine-131-labeled growth hormone of, techniques for rapidly producing, 18: 23225
plutonium body burden assessment in, 18: 23825 (LADC-6104)
radiation effects on lymphocytes of, x, 18: 23294
radiation effects on erythrocytes in, effects of monomer solutions on, 18: 23381
role of trace elements in degenerative diseases in, 18: 23199 (BNL-8
spermatogenesis rate in, tracer study of, 18: 23176

MANGANESE
alloying effects on iron–nickel alloys, 18: 24161
distribution of, in tissues of rats and man, 18: 23199 (BNL-828)
effects on phase transformation in steel, 18: 24152(T,R) (EURAEC-1001)
neutron reactions (n,γ) with, gamma spectra of fast and thermal, 18: 24699
neutron resonance integrals for, 18: 24625 (WASH-1046)
neutron scattering by, 18: 24625 (WASH-1046)
neutron total cross section at 0.01 ev to 50 kev, 18: 24678
role of, in etiology of degenerative diseases in man, 18: 23199 (BNL-828)
separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)
MANGANESE ALLOYS
Au–Mn, radiation and heat-treatment effects on electric and magnetic properties, 18: 24210
Mn–Sc, crystal structure of, 18: 24157
Mn–Zn, superconductivity in, effects of s-d exchange interactions in, 18: 24555
MANGANESE COMPOUNDS
preparation of plutonate, with perovskite structure, 18: 23521(P)
MANGANESE IONS
magnetic moments of configuration in rare earth manganates, 18: 24128 (CONF-405-34)
MANGANESE ISOTOPES Mn-51
energy levels, 18: 24660
MANGANESE ISOTOPES Mn-53
energy levels, 18: 24660
MANGANESE ISOTOPES Mn-55
neutron elastic scattering at 0.3 to 14 Mev, spin-spin interactions in, 18: 24645
neutron reactions (n,α) at 12.5 to 19.6 Mev, cross sections for, 18: 24602 (NP-13930(p.43-9))
proton elastic scattering at 5 and 14 Mev, spin-spin interactions in, 18: 24645
MANGANESE OXIDES
spectra in low frequency region, infrared, 18: 23549
MANNITOL
effect on titration of aqueous boric acid using sodium hydroxide, 18: 23412 (UCRL-7756)
MARCOULE REACTORS (G-2)
control data processing using numerical units for, 18: 24828
MARCOULE REACTORS (G-3)
control data processing using numerical units for, 18: 24828
MARITIME NUCLEAR STEAM GENERATOR
development, 18: 24939(R) (GEMP-285)
MARITIME REACTORS
design of water-cooled and -moderated, 18: 24946(P)
MASERS
frequency control in, 18: 24516(T) (JPRS-24633)
MASERS (OPTICAL)
diagnostic use for plasma refractivity studies, 18: 24783
emission processes in rare earth chelate, 18: 24229
theory of, 18: 24309
use for plasma diagnostics, 18: 24745 (ANL-6802(p.120-5))
MASS SPECTROMETERS
design and performance of quadrupole, 18: 23433
ion source design for, 18: 23406 (CONF-512-4)
testing, 18: 24300(R) (NP-13953)
uses in studying properties of excess-kinetic-energy ions in organic mass spectra, 18: 25019 (UCRL-10823)
MATERIALS TESTING
for nuclear rocket nozzles, 18: 24940 (NASA-CR-54000)
methods for determining radiation effects on reactor pressure vessels, nondestructive, 18: 23780(R) (SWRI-1243-11)
MATHEMATICAL TABLES
$\sin^2\theta$ vs θ and 2θ in 0.005 degree increments, 18: 24990 (IS-842)
MATHEMATICS
curve fitting, integration and interpolation programs for Philco 2000, 18: 24993 (KAPL-M-6139)
manipulation of matrices, computer program for, 18: 24060 (KAPL-M-6148)
model for prediction of population growth, 18: 25012 (TID-20579)
weakly positive matrices, 18: 24062
MATTER
sound excitation in nuclear, zero, 18: 24693
MECHANICS
Boltzmann's equation, derivation of, 18: 24507
theory of transport processes in, general, 18: 24231
MEDICINE
use of radioisotope renogram in internal, 18: 23393
MEDITERRANEAN SEA
uranium content of western, 18: 23787
MELTING
freezing point depression due to anomalous crystal habit and by limitation of crystal size, 18: 25028(T) (ORNL-tr-72)
MEMORY DEVICES
development of thin-film fast magnetic memories, 18: 23862
matching ferrite operative and permanent, methods for, 18: 24516(T) (JPRS-24633)
use of storage tubes for high-speed pulse amplitude analysis, 18: 24021
MENDELEVIUM
separation from europium by solvent extraction using TBP–nitric acid and TBP–hydrochloric acid systems, 18: 23725
MERCURY
crystallographic analysis of solid, 18: 24994(R) (MND-2531-1)
determination by double activation analysis, 18: 23425
neutron scattering by, 18: 24625 (WASH-1046)
plasma of, resonance probe diagnostics of, 18: 24771
separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)
separation from radioactive waste solutions by amalgamation with aluminum or copper, 18: 24977 (ORNL-TM-827)
MERCURY ALLOYS
Hg–K, performance in fuel cells, 18: 24354 (ANL-6802(p.49-52))
MERCURY COMPOUNDS
use as fixatives for electron microscopy, 18: 23162(R) (ANL-6823 (p.174-7))
MERCURY OXIDES
spectra in low frequency region, infrared, 18: 23549
MESONS
electromagnetic moments and leptonic decays of intermediate $W^{\pm}$, 18: 24464
interactions with baryons, use of reciprocal bootstrap in SU(3) symmetry in, 18: 24431
interactions with baryons in $U(3) \otimes U(3)$ symmetry, resonance, 18: 24465
interactions with nucleons, phase-shift linearization of differential cross sections for, 18: 24472
photoproduction of 300- to 400-Mev ABC, excitation curve analysis of, 18: 24381 (ISS-64/4)
MESONS (B)
decay $(\omega^0 + \pi^0)$, 18: 24463
MESONS (η)
coupling constant of, with nucleon, 18: 24411
decay of, G_2 symmetry in, 18: 24441
emission in meson (π^-) interactions with nucleons at 7 Bev, 18: 24391 (JINR-P-1629)
photoproduction on protons, cross sections for, 18: 24438
MESONS (η^0)
emission in Y^* decay, 18: 24387 (JINR-P-1615)
interactions with hyperons (Λ), resonance, 18: 24387 (JINR-P-1615)
photoproduction on protons, excitation curve analysis of, 18: 24381 (ISS-64/4)
MESONS (f^0)
decay into mesons (π^0), 18: 24463
isotopic spin, 18: 24463
isotopic spin, 18: 24466
MESONS (K)
production in meson (π) reactions with beryllium-9, cross sections for, 18: 24587 (JINR-P-1584)
MESONS (K^-)
interactions in nuclear emulsions at 800 Mev/c, measurement of short-range hyperfragments from, 18: 24445
interactions with protons, hyperon (Σ) leptonic decay in, 18: 24402 (TID-

19033)
interactions with nucleons at high energies, parameters for, 18: 24384 (JINR-P-1577)
reactions in emulsions, nonmesic hyperfragment production, 18: 24654
reactions with emulsion nuclei, hyperon (Σ) production in, 18: 24415

MESONS (K^+)
interactions with protons at 3 Bev/c, mechanism of ($K^+\pi^+p$) production in, 18: 24449
interactions with deuterons in $I = 0$ state at low energies, 18: 24457
interactions with protons at 7 to 14 Bev/c, differential cross sections for elastic, 18: 24396(R) (NP-13947)
production in gamma-proton interactions at 950 to 1050 Mev, 18: 24428

MESONS ($K_{\mu 3}$)
decay of, form factors in, 18: 24447

MESONS ($K^{+}_{\mu 3}$)
decay of, form factors in, 18: 24447

MESONS (μ)
capture by heavy nuclei, theory of, 18: 24658
momentum of high-energy, determination using emulsions, 18: 23945
theory, 18: 24469

MESONS (μ^-)
decay with two kinds of neutrinos, electron spectra in, 18: 24405

MESONS (μ^+)
decay of, positron depolarization by bremsstrahlung in, 18: 24435

MESONS (ω)
coupling constant of, with nucleon, 18: 24411

MESONS (ω^{ρ})
photoproduction on protons, excitation curve analysis of, 18: 24381 (ISS-64/4)

MESONS (ϕ)
decay of, G_3 symmetry in, 18: 24441
production in meson (π^-)-p interactions, 18: 24396(R) (NP-13947)

MESONS (π)
coupling constant of, with nucleon, 18: 24411
emission in meson (π^-) interactions with nucleons at 7 Bev, 18: 24391 (JINR-P-1629)
form factors of, asymptotic behavior of, 18: 24471
interactions of, model for resonance, 18: 24443
interactions with nucleons, single-meson exchange in, 18: 24477
interactions with nucleons, coupling constants for, 18: 24423
interactions with mesons (π), inverse amplitude solution for low-energy, 18: 24425
interactions with baryons, resonance poles in, 18: 24429
interactions with deuterons, poles of generation amplitudes for, 18: 24470
interactions with nucleons, mechanisms of low-energy, 18: 24474
interactions with protons at 7 to 20 Bev, diffraction-scattering, 18: 24392 (JINR-P-1632)
interactions with mesons (π) at low energies, threshold behavior of partial amplitudes in, 18: 24413
interactions with nucleons in shell model, constants and coupling in, 18: 24414
ionization reactions with gases, spark chamber studies of, 18: 24473
photoproduction on protons, single, 18: 24380 (DESY-64/3)
production in meson (π) reactions with beryllium-9, cross sections for, 18: 24587 (JINR-P-1584)
production in nucleon resonant interactions, 18: 24479

MESONS (π^-)
absorption by emulsion nuclei, 18: 24582 (AD-439331)
capture by nucleons in propane, 18: 24475
decay branching ratio $(e^- + \bar{\nu})/(\mu^- + \bar{\nu})$, 18: 24406
interactions in hydrogen bubble chamber at Saclay, computer analysis of tracks from, 18: 23887 (PAN-474/VI)
interactions with protons at 9 Bev, gamma production in, 18: 24417
interactions with protons at 871 Mev, multiple meson (π) production in, 18: 24418
interactions with protons at high energies, fundamental lengths in, 18: 24436
interactions with deuterons, energy and angular distributions from, 18: 24451
interactions with protons at 500 to 1000 Mev, cross sections for elastic, 18: 24454
interactions with deuterons, neutron-neutron scattering length in, 18: 24462
interactions with nucleons at 7 Bev, 18: 24391 (JINR-P-1629)
interactions with carbon nucleons, parity conservation in hyperon (Λ^0) production in, 18: 24394 (NEVIS-122)
interactions with protons, W-boson production in, 18: 24397 (NP-1395
interactions with nucleons at high energies, parameters for, 18: 2438 (JINR-P-1577)
interactions with protons at high energies, dispersion relations for, 18: 24386 (JINR-P-1598)
interactions with protons at 7 to 8 Bev/c, hyperon (Λ) resonances in, 18: 24387 (JINR-P-1615)
production in meson (π^-)-proton interactions at 871 Mev, 18: 24418
production in proton interactions at 650 Mev, angular and energy distributions in, 18: 24476
reactions with carbon and nitrogen at 7.5 Bev, 18: 24390 (JINR-P-162
reactions with carbon and nitrogen at 7 Bev, 18: 24391 (JINR-P-1629)
reactions with nuclei at 7 Bev/c, particle production in, 18: 2458 (JINR-P-1584)
scattering by emulsion particles, cross sections for elastic, 18: 2394
scattering by nuclear emulsion particles, distributions from, 18: 2394

MESONS (π^0)
decay of, G_3 symmetry in, 18: 24441
decay of, Goldberger-Treiman formula for two-gamma, 18: 24434
photoproduction on protons, angular distributions from, 18: 24396(R) (NP-13947)
production in meson (π^-)-proton interactions, cross sections for, 18: 24417
production in proton interactions at 650 Mev, angular and energy distributions in, 18: 24476
properties, 18: 24390 (JINR-P-1624)

MESONS (π^+)
interactions with protons, elastic differential cross sections for, 18: 24424
interactions with protons at high energies, fundamental lengths in, 18: 24436
interactions with protons at 500 to 1600 Mev, cross sections for elastic, 18: 24453
interactions with deuterons, meson (f^0) production in, 18: 24463
interactions with nucleons, isotopic spin of meson (f^0) from, 18: 244
interactions with protons at 600 Mev, branching ratios and cross sections for, 18: 24396(R) (NP-13947)
interactions with protons, W-boson production in, 18: 24397 (NP-1395
interactions with polarized protons at 250 Mev, polarization parame 18: 24404 (UCRL-11149)
interactions with nucleons at high energies, parameters for, 18: 243 (JINR-P-1577)
interactions with protons at high energies, dispersion relations for, 18: 24386 (JINR-P-1598)
production in meson (π^-)-proton interactions at 871 Mev, 18: 24418
production in proton interactions at 650 Mev, angular and energy distributions in, 18: 24476

MESONS (ρ)
coupling constant of, with nucleon, 18: 24411
exchange in isobar production model, ρ-photon analogy in, 18: 2445

MESONS (ρ^0)
photoproduction on protons, excitation curve analysis of, 18: 24381 (ISS-64/4)

METABOLISM
of radionuclides in beagles, 18: 23184(R) (ANL-6823(p.44-75))
phosphorus-32 uptake by wheat seeds, effects on, 18: 23205(T) (JPRS-24290(p.36-42))
radiation effects on rat liver, x, 18: 23233(R) (ANL-6823(p.157-60))
radiation effects on bull spermatozoa, gamma, 18: 23297
radiation effects on sperm, gamma, 18: 23334

METAL-FOIL DETECTORS
neutron activation integrals for, computer program for, 18: 23871 (ANL-6822)
use of gold as, for absolute neutron flux measurements, 18: 23876 (KFK-180)

METAL SYSTEMS
free energies of interaction of metal-metallic salt systems,

18: 24996(R) (NAA-SR-8888(Sect.VI))
METALLIC FILMS
preparation and properties of thin, ultra-high-vacuum system for, 18: 24225
METALLIC FOILS
crystallographic analysis of, 18: 24994(R) (MND-2531-1)
METALLOGRAPHY
electrolytic polishing uses in, 18: 24107(T) (SC-T-64-903)
METALS
age-hardening of theories and mechanisms of, 18: 24154(T) (RSIC-174)
book: *Constitution Diagrams of Metal Systems*, 18: 24180
book: *Constitution Diagrams of Metal Systems*, 18: 24181
chemisorption of gases by, 18: 25033(T) (SC-T-64-901)
coating with uranium oxide by electrolytic deposition in sodium fluoride, 18: 23557
conductivity electron scattering by impurity centers in, mechanisms of momentum transfer in, 18: 24167
conference on application of high pressure in metal-deformation processing, Bureau of Naval Weapons, BMI, Columbus, Ohio, Oct. 3, 1963, 18: 24099 (DMIC-199)
corrosion by high-temperature gases, electrical process for protection against, 18: 24092(P)
electric conductivity of, electron-phonon interactions in, 18: 24557
electron beam reactions with, plasma production from melting in, 18: 24798
heat transfer during film condensation of vapors from liquid, 18: 23768 (MIT-2995-1)
heating liquid, space-borne thermionic generators for, 18: 24370(R) (PWA-2337)
phase transformations in, analysis of martensitic, 18: 24994(R) (MND-2531-1)
reactions with polyacrolein, effects of pH and temperature on, 18: 23542
role of trace, in physiology and pathology of man, 18: 23199 (BNL-828)
technology of high-temperature liquid, review, 18: 24064
theory of localized states in, impurity pairs in many-body, 18: 24170
METEORITES
analysis of achondritic, for thorium and uranium, 18: 24286
analysis of chondritic, for thorium and uranium, 18: 24285
osmium and rhenium content in stony, 18: 24292
METEOROLOGY
effects of thermonuclear warfare on, 18: 23822 (HI-303-RR/A-IV)
effects of wind-driven currents on eddy viscosity at various ocean depths and structure of wind waves, 18: 25013 (TID-20612)
particle collection efficiency of raindrops in lower atmosphere, 18: 24212 (HW-SA-3167)
radon distribution in lower atmosphere and, 18: 24213
METHACRYLAMIDE
polymerization induced by irradiation and heat treatment, 18: 23652(T,R) (AEC-tr-6316(p.587-97))
radioinduced reactions with gases, 18: 23650(T,R) (AEC-tr-6316(p.567-72))
METHACRYLAMIDE POLYMERS
radioinduced reactions with gases, 18: 23650(T,R) (AEC-tr-6316 (p.567-72))
METHACRYLIC ACID, ESTERS
radioinduced graft polymerization on polyvinyl alcohol, gamma, 18: 23583(T,R) (AEC-tr-6316(p.76-8))
METHACRYLIC ACID, METHYL ESTER
production by low-temperature radioinduced polymerization of isopropylamine, 18: 23591(T,R) (AEC-tr-6316(p.129-30))
radioinduced graft polymerization on polyoxymethylene, 18: 23607(T,R) (AEC-tr-6316(p.223-6))
radioinduced graft polymerization on cotton and rayon, gamma, 18: 23658(T,R) (AEC-tr-6316(p.650-9))
radioinduced polymerization with acrylonitrile and styrene on alumina base, gamma, 18: 23594(T,R) (AEC-tr-6316(p.137-44))
radioinduced polymerization with β-propiolactone, 18: 23604(T,R) (AEC-tr-6316(p.190-4))
METHACRYLIC ACID, METHYL ESTER POLYMERS
radiation behavior of, effects of pigments on, 18: 24199(T,R) (AEC-tr-6316(p.359-67))
radiation effects on electric conductivity of, electron and gamma, 18: 24203
radioinduced free radicals in, singlets in electron spin resonance spectra produced at high doses, 18: 23616(T,R) (AEC-tr-6316(p.306-9))
radioinduced free radicals in, output saturation in electron spin resonance spectra of, 18: 23617(T,R) (AEC-tr-6316(p.310-13))
radioinduced free radicals in, concentration of, 18: 23618(T,R) (AEC-tr-6316(p.314-21))
METHANE
neutron scattering by rotating states in, 18: 24299 (NP-13930(p.56-7))
radioinduced reactions with Teflon, electron spin resonance studies of, 18: 23648(T,R) (AEC-tr-6316(p.534-7))
radiolysis of solid, formation of viscous polymeric oil in, at 77°K in, 18: 23697
METHANE, IODO-
electric conductivity of aluminum, gallium, and indium iodides in, 18: 23449 (PAN-491/V)
METHANE, NITRO-
solvent properties for cerium, 18: 23727
METHANESULFONIC ACID, ETHYL ESTER
genetic effects of, in wheat, 18: 23320
METHANOL
effects on radioinduced graft polymerization of styrene on polyvinyl alcohol, 18: 23581(T,R) (AEC-tr-6316(p.66-9))
effects on radioinduced graft polymerization of styrene on polyvinyl alcohol, 18: 23582(T,R) (AEC-tr-6316(p.70-5))
lactone, radioinduced polymerization with β-propiolactone, 18: 23605(T,R) (AEC-tr-6316(p.201-7))
METHIONINE
effects of thiophosphamide on uptake of sulfur-35-labeled, by blood serum, 18: 23247(T) (JPRS-24164(p.1-8))
photolysis of, transformation of amino acids in uv, 18: 23204(T) (JPRS-24164(p.19-42))
radiation effects on rat tissue uptake of carbon-14-labeled, x, 18: 23293
synthesis in Saccharomyces, 18: 23193(R) (ANL-6823(p.128-40))
use of selenium-75-labeled, in radiodiagnosis of pancreatic diseases, 18: 23392
METHYL GROUP
rotational dynamics of, 18: 24625 (WASH-1046)
METHYLAMINE
dissociation by electron bombardment, mass spectra from, 18: 23608(T,R) (AEC-tr-6316(p.232-7))
MICE
calcium-45 and strontium-85 retention in, effects of tetracycline on, 18: 23220
catalase reduction in erythrocytes of, 18: 23186(R) (ANL-6823(p.86-90))
catalase-inhibition by 5-mercapto-1,2,3,4-tetrazole in, 18: 23187(R) (ANL-6823(p.91-8))
dietary effects of cesium-137 and strontium-90 on mortality, reproduction, and tumor tolerance in, 18: 23210
enzyme activity in kidney of, after uranyl nitrate intoxication on, 18: 23213
genetic effects of radiomimetic agents on fertility in, 18: 23177
kidney lesions induced by uranyl nitrate in, microstructural, 18: 23214
nucleic acid metabolism in tumor cells from, effects of tritium on, 18: 23215
plutonium uptake by bones and liver of, protective effects of diethylenetriaminepentaacetic acid against, 18: 23350(R) (ANL-6823(p.105-8))
plutonium-239 removal from, using calcium salt and pentaethyl ester of carboxymethyliminobis(ethylenenitrilo)tetraacetic acid, 18: 23369
protection against radiation injuries in, evaluation of 23 chemical compounds for, 18: 23354(R) (NP-13918(p.58-74))
protection against radiation injuries in, evaluation of chemical compounds for, 18: 23355(R) (NP-13918(p.75-98))
radiation dose to gonads of, beta, 18: 23185(R) (ANL-6823(p.76-80))
radiation effects on survival and tumorigenesis in, gamma and neutron, 18: 23230(R) (ANL-6823(p.15-19))
radiation effects in, lethal, 18: 23245 (UR-654)
radiation effects on susceptibility to virus infections of, 18: 23248(T) (JPRS-24696)
radiation effects on histology and saline-soluble DNA content in spleen of, 18: 23257
radiation effects on microstructure of duodenum cells of, x, 18: 23266

radiation effects on wound healing in, 18: 23273
radiation effects on postnatal development of cerebellum in, 18: 23284
radiation effects on aging and kidney function in, x, 18: 23291
radiation effects on corneal epithelium in, proton, 18: 23303
radiation effects on fertility of, x, 18: 23325
radiation effects on reproduction in, gamma, 18: 23326
radiation effects on reproduction in, gamma, 18: 23328
radiation effects on reproduction in, 18: 23329
radiation effects on survival of, factors affecting, 18: 23347
radiation effects on, protective effects of diethylenetriaminepentaacetic acid against, plutonium, 18: 23351(R) (ANL-6823(p.114-15))
radiation effects on, use of nicotinic acid derivatives to treat, 18: 23365
radiation effects on, protective effects of 3-alkyl-1,3-thiazane derivatives against, x, 18: 23370
radiation effects on, protection against, using chlorotrianise, 18: 23371
radiation effects on, protective effects of antibiotics against, 18: 23380
radiation effects on, effects of procaine on, 18: 23384
radiation injuries in, protection against using sodium nitrate, 18: 23356(R) (NP-13918(p.99-106))
radiation injuries in, protective effects of *p*-aminopropiophenone against, 18: 23357(R) (NP-13918(p.107-15))
radiation injuries in, protective effects of amino compounds combined with thiols, 18: 23385
radiation injury to chromosomes of testes in, protection against, using streptomycin, 18: 23359(T) (JPRS-24593(p.120-5))
radiation sickness in, effects of flu virus vaccine and bone marrow injections on, 18: 23366
radiation- and hydrocarbon-induced tumors in, 18: 23349
radioinduced bone sarcomas in, beta and x, 18: 23231(R) (ANL-6823 (p.20-43))
radioinduced lymphoid leukemia in, plasma lactic dehydrogenase activity in, 18: 23256
radiosensitivity of, effects of strain on, 18: 23251(T) (JPRS-24803)
toxic effects of 2-mercaptoethylamine or *p*-aminopropiophenone in diet of normal and irradiated, 18: 23358(R) (NP-13918(p.116-28))
tumor growth in, effects of fatty acids from liver of irradiated rabbits on, 18: 23208

MICROSCOPES
performance for particle track analysis in emulsion, 18: 23941
performance of digitized-travel, for particle track analysis in emulsions, 18: 23940

MICROWAVES
amplification, 18: 24516(T) (JPRS-24633)
emission by plasma column, resonance structure of, 18: 24786
emission from rare-gas discharges, resonance in, 18: 24772

MILK
fallout monitoring in Swedish, 1962, 18: 23790 (NP-13828)
fallout products in, distribution of, 18: 23800
iodine-131 and strontium-89 and -90 content of cow's, 18: 23829
iodine-131 content of, effects of atmospheric radioactivity and rainfall on, 18: 23819 (CEA-R-2409)
iodine-131 content of, in France, 1962 and 1963, 18: 23819 (CEA-R-2409)
radioactivity of, from fallout in India, 1962 and 1963, 18: 23789 (AEET/AM/39)

MINING
underground nuclear explosion applications in, evaluation of, 18: 23751 (UCRL-7350)

MISSILES
impact of cylindrical, effects on ground, 18: 25001(R) (SC-DC-64-459)

MITOCHONDRIA
radiation effects on oxidative phosphorylation in rat liver, x, 18: 23233(R) (ANL-6823(p.157-60))

MITOSIS
cytology of Paramecium, 18: 23163(R) (ANL-6823(p.178-88))
of hamster cells in culture, electron microscopic studies of chromosomes during metaphase, 18: 25008 (TID-19032)
radiation effects on bean seed, gamma, 18: 23252(T) (ORNL-tr-84)
radiation effects on *Aedes aegypti*, x, 18: 23262
radiation effects on mouse kidney, x, 18: 23291

MIXER-SETTLERS
liquid-liquid separation by gravity-induced settling in, effects of induced coalescence on, 18: 23708 (UCRL-11182)

MOLDS
radiation effects on spores of *Rhizopus stolonifer*, protective effects of germination inhibition and oxygen against, 18: 23288

MOLECULAR STRUCTURE
analysis of, computer methods for, 18: 24296(R) (AD-417517)

MOLECULES
collisions of, vibrational transition in, 18: 24320
interactions with molecules, cross sections for vibrational transitions in, 18: 24322
interactions with molecules, distorted-wave method in inelastic, 18: 24323
neutron scattering by rotating states in, 18: 24299 (NP-13930(p.56-7))

MOLLUSKS
strontium-90 content of, from Pacific Ocean in vicinity of Japan, 1959 through 1961, 18: 23792 (WP/37)

MOLTEN SALT REACTOR EXPERIMENT
fuel and structural materials compatibility, capsule irradiation test on, 18: 24907 (ORNL-TM-870)

MOLYBDENUM
alloying effects on physical properties of iron–nickel alloys, 18: 24159
alloying effects on iron–nickel alloys, 18: 24161
corrosion by lithium hydrides at 1165 to 1600°F, 18: 24085(R) (NASA-CR-54053)
effects on phase transformations in steel, 18: 24152(T,R) (EURAEC-1001)
emissivity of coated, in vacuum, 18: 24138(R) (PWA-2206(Vol.I))
emissivity of coated, in vacuum, 18: 24139(R) (PWA-2206(Vol.II))
emissivity of coated, in vacuum, 18: 24140(R) (PWA-2206(Vol.III))
melting of, effects of additives, arc current, and electrode density on vacuum-arc, 18: 24070 (RTD-TDR-63-4089)
neon atom and ion bombardment, electron spectra from, 18: 24318
neutron capture by, use of lead spectrometer for studying, 18: 2460 (NP-13930(p.110-11))
neutron scattering by, optical model analysis of, 18: 24625 (WASH-10
performance as electrodes in ion engines in spacecraft, 18: 23740(R) (NP-13899)
performance as fuel cladding in fast reactors, 18: 24952(R) (ANL-6880(p.6-48))
performance in thermionic cells, effects of additives on, 18: 24350(R) (AD-418276)
separation from neodymium by ion exchange and solvent extraction, 18: 24856(R) (GEAP-4430)

MOLYBDENUM ALLOY COUPLES
Mo–Ni/Ti, solid state bonding of, 18: 24112
Mo–Ti/Ti, solid state bonding of, 18: 24112

MOLYBDENUM ALLOYS
mechanical properties of, effects of strain softening on, 18: 24119 (AD-425148)
Cr–Cu–Fe–Mo–Ni, performance of Ni–O–Nel 825 in nuclear superhea environment, 18: 24886(R) (GEAP-4565)
Fe–Mo, vacancy formation in, 18: 24160
Ge_3Mo, shear modulus and sound velocity of, 18: 24174
Mo–Nb, electric and mechanical properties, 18: 24158
Mo–Nb, hydrogen affinity of, 18: 24165
Mo–Nb, solid-state bonding of, 18: 24112
Mo–Nb–V–Zr, fabrication and properties of coated B-66, 18: 24068(R) (NP-13955)
Mo–Nb–V–Zr, fabrication of extruded B-66, 18: 24093(R) (AD-4245
Mo–Nb–W, factors affecting vacuum-arc melting of, 18: 24070 (RTD-TDR-63-4089)
Mo–Pu–U, performance as zero-power reactor fuel, 18: 24952(R) (ANL-6880(p.6-48))
Mo–Re, hydrogen affinity of, 18: 24165
Mo–Sn–U, fission effects on, reduction of swelling in, 18: 24996(R) (NAA-SR-8888(Sect.VI))
Mo–Ti, factors affecting vacuum-arc melting of, 18: 24070 (RTD-TDR-63-4089)
Mo–Ti, mechanical properties of, strain-softening effects on, 18: 24119 (AD-425148)
Mo–Ti, solid-state bonding of, 18: 24112
Mo–Ti–*Zr*, corrosion by potassium at 2000 to 2200°F, 18: 24091

Mo–Ti–Zr, factors affecting vacuum-arc melting of, 18: 24070 (RTD-TDR-63-4089)
Mo–Ti–Zr, performance as fuel cladding in fast reactors, 18: 24952(R) (ANL-6880(p.6-48))
Mo–U, evaluation as HNPF fuel, 18: 24892(R) (NAA-SR-8888(Sect.II))
Mo–U, phase transformations in, 18: 24124 (CEA-2341)
Mo–W, factors affecting vacuum-arc melting of, 18: 24070 (RTD-TDR-63-4089)
MOLYBDENUM COUPLES
Mo–Re/Re, development of thermocouples of, 18: 24937 (APEX-917)
MOLYBDENUM ELECTRODES
performance of perforated, as ion sources, 18: 24366 (ASD-TDR-63-750)
MOLYBDENUM ISOTOPES Mo-92
oxygen-16 reactions with, coulomb excitation in, 18: 24620(R) (ORNL-TM-874)
MOLYBDENUM ISOTOPES Mo-93
decay of, semiconductor detection of, 18: 23990
MOLYBDENUM ISOTOPES Mo-99
chemical effects on specific surface of molybdenum disulfide, 18: 23696
MOLYBDENUM OXIDES
spectra in low frequency region, infrared, 18: 23549
Li_2MoO_4–MoO_3, temperature effects on density and electric conductivity of, 18: 23486
MoO_3–K_2MoO_4, temperature effects on density and electric conductivity of, 18: 23486
MOLYBDENUM OXYCHLORIDES
preparation and properties of oxidetetrachloride, 18: 23465
MOLYBDENUM SILICIDES
shear modulus and sound velocity of, 18: 24174
thermal expansion of, mean coefficient of, 18: 24173
MOLYBDENUM STEEL
ductility of, effects of hydrogen on, 18: 24153(T,R) (EURAEC-1002)
MOLYBDENUM SULFIDES
lubricity, 18: 23742 (TID-7690(p.106-20))
surface area of, effects of radiation from sulfur or molybdenum-99 on, 18: 23696
MOLYBDENUM SYSTEMS
C–Mo–Nb–W–Zr, corrosion by potassium at 2000 to 2200°F, 18: 24091
Mo–Si–U, fission effects on, reduction of swelling in, 18: 24996(R) (NAA-SR-8888(Sect.VI))
MONKEYS
radiation effects on chromosome aberrations in spermatogenesis of *Macaca mulatta* at 5 to 400 r, gamma, 18: 23317
radiation effects on testes of, gamma, 18: 23330
MONTE CARLO METHOD
computer program for, CEP, 18: 24377 (AEEW-M-442)
use in reactor eigenvalue calculations, 18: 24818 (WAPD-T-1649)
MOON
effect on equatorial spread-F, 18: 24535
induction of tidal oscillations in E layer of ionosphere, 18: 24533
radio emission at 50 cm from, 18: 24516(T) (JPRS-24633)
MOSQUITOES
radiation control of malaria vector, 18: 23168(R) (STI/DOC/10/25(p.99-111))
radiation effects on cytogenetics in *Aedes aegypti*, x, 18: 23262
MÖSSBAUER EFFECT
time dependence of resonance fluoresence from identical nuclei, 18: 24228
MUCOPROTEINS
separation and purification of, method for, 18: 23188(R) (ANL-6823 (p.102-4))
MULTIPLICATION FACTOR
calculation of reactor eigenvalues using Monte Carlo method, 18: 24818 (WAPD-T-1649)
calculation of small-amplitude auto-oscillations in reactors, 18: 24850 (NP-13963)
in thermal reactors, fast neutron, 18: 24846 (EUR-1618.e)
measurement of Doppler coefficient, 18: 24816(R) (NAA-SR-8888 (Sect.IV))
MUTATIONS
effects of somatic, on aging, 18: 23165 (BNL-854)
plastid development and chlorophyll production in Chlorella, 18: 23196(R) (ANL-6823(p.161-4))
radioinduced and chemically induced, in durum wheat, 18: 23320
radioinduced in Phaseolus for chlorophyll, x, 18: 23263
MYOSINS
radiation effects on ATPase activity of, x, 18: 23258

N

NAVAL REACTORS
fuel elements for, design of thermionic, 18: 24857(R) (GEST-2031)
NEBULAE
model for H_{II} region formation, 18: 24276
model of Orion, for formation of H_{II} region, 18: 24275
NEODYMIUM
heat of solution in liquid tin at 750°K, 18: 24183
magnetic properties of, effects of crystalline field and structure on 18: 24186
polarographic behavior in tetraethylammonium bromide at dropping mercury electrode, 18: 23463
proton reactions (p,ypxn) at 660 Mev, production of neutron-deficient radioactive rare earths in, 18: 24691
separation from irradiated clad uranium dioxide fuels, 18: 24856(R) (GEAP-4430)
NEODYMIUM ALLOYS
Fe_2Nd, neutron diffraction study of magnetic behavior and structure, 18: 24184
NEODYMIUM CHLORIDES
solubility of gypsum in aqueous solutions of, 18: 23536
NEODYMIUM COMPLEXES
with EDTA, stereochemistry of, 18: 23518
NEODYMIUM IONS
electron paramagnetic resonance in calcium fluorides, spin-lattice relaxation in, 18: 23527
energy transfer to, from uranyl ions in barium crown glass, radiationless resonance, 18: 24223
NEODYMIUM ISOTOPES Nd-142
effects on proton polarization in lanthanum magnesium nitrates, 18: 23444 (JINR-P-1626)
NEODYMIUM ISOTOPES Nd-144
carbon reactions (C-12,7n) at 108 Mev, recoil ranges in, 18: 24734
NEODYMIUM ISOTOPES Nd-147
production in neon-22 and oxygen-18 reactions with thorium-232, 18: 24690
NEODYMIUM ISOTOPES Nd-149
production in neon-22 and oxygen-18 reactions with thorium-232, 18: 24690
NEODYMIUM ISOTOPES Nd-150
oxygen-16 scattering at 38 to 48 Mev, level excitation in, 18: 24729
NEODYMIUM OXALATES
dynamic decomposition of, effects of air, carbon dioxide, and nitrogen on, 18: 23507
NEODYMIUM OXIDES
catalytic effects on deuterium, exchange in cyclohexane, 18: 23573
deposition on aluminum, electrolytic, 18: 23537
magnetic susceptibility at 4.2 to 300°K, 18: 23513
spectra in low frequency region, infrared, 18: 23549
CeO_2–Nd_2O_3, equilibrium phase studies on, 18: 23509
Nd_2O_3–ZrO_2, crystal structure, differential thermal analysis, and thermal expansion of, 18: 23503
NEODYMIUM SYSTEMS
Nd–Te, crystal chemistry and phase studies of, 18: 23506
NEON
electric discharge in, microwave resonance emission spectra of, 18: 24772
electric discharge in, stability of, 18: 24784
electron reactions at 25 to 150 ev, photon emission in, 18: 24700
ionization in spark chambers by charged particles, 18: 24473
reactions with molybdenum, electron spectra from, 18: 24318
NEON IONS
reactions with molybdenum, electron spectra from, 18: 24318
reactions with nuclear emulsions, effects of energy and mass on grain darkening in, 18: 23916

NEON ISOTOPES
separation by thermal diffusion, 18: 24050(R) (ORNL-3607)
spectrum of solar, 18: 24326
NEON ISOTOPES Ne-20
alpha reactions (α,C-12) with, cross section fluctuations in, 18: 24625 (WASH-1046)
helium reactions (He-3,n) at 25 Mev, spectra of, 18: 24650
reactions with bromine and silver at 200 Mev, mechanisms of, 18: 24732
reactions with nickel at 130 Mev, production of proton emitters in, 18: 24737
reactions with rare earths, effective charge distribution from, 18: 24624 (UCRL-10806)
reactions with tantalum at 160 Mev, multinucleon stripping in, 18: 24717
reactions with uranium-238 at 90 to 150 Mev, production of spontaneously fissioning isomer in, 18: 24725
NEON ISOTOPES Ne-22
reactions with rare earths, effective charge distribution from, 18: 24624 (UCRL-10806)
reactions with thorium-232 and uranium-238, yields from, 18: 24689
reactions with thorium-232, yields from, 18: 24690
reactions with thorium-232 at 157 Mev, fission fragment distributions and yields in, 18: 24735
reactions with uranium-238 at 90 to 150 Mev, production of spontaneously fissioning isomer in, 18: 24725
reactions with uranium-238 at 147 Mev, fission fragment distributions and yields in, 18: 24735
NEPTUNIUM
reduction by vanadium in perchloric acid, kinetics and thermodynamics of, 18: 23485
separation from irradiated uranium by ion exchange, 18: 23726
separation from protactinium by ion exchange, 18: 23409 (RT/CHI(63)-31))
NEPTUNIUM ISOTOPES Np-237
distribution and retention in rat adrenals, 18: 23221
proton fission of, 18: 24625 (WASH-1026)
NERVES
radiation effects on regeneration after traumatic injury of, in dogs, 18: 23250(T) (JPRS-24704(p.12-17))
radiation effects on action-potential of, effects of sodium azide on, 18: 23277
NERVOUS SYSTEM
radiation effects on peripheral, in liver of dogs and rabbits, 18: 23309
radiation effects on dogs and rabbits, 18: 23377
radiation sickness effects on central, in dogs, 18: 23310
NEUTRINOS
detection of solar, review, 18: 24295
interactions with cosmic rays in universe, theory of, 18: 24348
NEUTRON ACTIVATION CROSS SECTIONS
measurement of, for various nuclei at 14.7 Mev, 18: 24613 (NP-13930 (p.139))
NEUTRON BEAMS
depolarization in passage through magnetized iron, 18: 24568 (NP-13930 (p.78-9))
NEUTRON CAPTURE CROSS SECTIONS
research programs at ORNL, 18: 24620(R) (ORNL-TM-874)
NEUTRON CROSS SECTIONS
measurement for manganese, 18: 24678
measurement of differential and total, for slow neutrons, 18: 24606 (NP-13930(p.73-4))
measurement using Karlsruhe Van de Graaff generator, program for, 18: 24246 (NP-13930(p.137-8))
measurements, 18: 24625 (WASH-1046)
NEUTRON FISSION CROSS SECTIONS
measurement of, fast electronics for, 18: 24015
NEUTRON SHIELDING
development of plastic-lined, 18: 24809(P)
production of, method for, 18: 24079(P)
NEUTRON SOURCES
design of compact, using duoplasmatron ion source, 18: 24247 (NP-13930(p.140))
design of strong pulsed, 18: 24570 (NP-13930(p.141-3))
design of thermal, for linear accelerator, 18: 23896
efficiency of D-T, effects of target "reloading" on, 18: 24579
reactivity transients from pulsed, in reactors, 18: 24851 (ORNL-TM-570)
NEUTRON SPECTRA
measurement of fast, using lithium-6 semiconductor counter telescope, 18: 23986
measurements of, using semiconductor detectors, 18: 23884 (NP-13930(p.159-77))
time dependence of, in beryllium and heavy water, 18: 24571(R) (RPI-328-6)
NEUTRON SPECTROMETERS
control of, using IBM-1620 computer, 18: 24009
design for high-intensity time-dependent fast neutron environment, 18: 24008
design of nanosecond time coder with large analysis range for time-of-flight, 18: 24018
design of nanosecond time coder with large analysis range for, 18: 24019
design of precision crystal, 18: 23881 (NP-13930(p.128-9))
design of rotating-cyrstal, 18: 23879 (NP-13930(p.126))
design of time-of-flight, for fast neutrons, 18: 23882 (NP-13930(p.144-6))
design of time-of-flight digital system for, 18: 24022
design of, using back-scattering of protons from polyethylene films, 18: 23883 (NP-13930(p.147-57))
design using two semiconductor detectors, 18: 23884 (NP-13930(p.159-77))
operation of rotating-crystal, use of preselector for suppression of reflection of higher orders in, 18: 23880 (NP-13930(p.127))
performance of lithium-6 semiconductor, 18: 23986
positioning of triple-axis, graphical method for, 18: 23870 (AERE-R-4380)
pulse-time codes for time-of-flight, 18: 23996
use of CDC 160-A computer for multiparameter-multichannel analysis for, 18: 23859
NEUTRON SPECTROSCOPY
performance of emulsions and junction detectors for fast, 18: 23960
NEUTRONS
absorption and transmission by nuclei, optical model calculations of, 18: 24595 (NP-13930(p.6-13))
age measurements in diphenyl, graphite, water, and water-metal mixtures, 18: 24996(R) (NAA-SR-8888(Sect.VI))
book: *An Introduction to Neutron Transport Theory*, 18: 24581
capture by nuclei, use of lead spectrometer for studying, 18: 24608 (NP-13930(p.110-11))
capture by nuclei, analysis of gamma spectra from, 18: 24620(R) (ORNL-TM-874)
collision probability codes for cylindrical lattices for IBM-704, 18: 24844 (ANL-6836)
conference on neutron physics, Karlsruhe, Germany, Oct. 8 to 10, 1963, 18: 24567 (NP-13930)
detection and measurement of, from uranium fluoride deposits in process equipment, 18: 23875 (K-1586)
detection and measurement of, development of transistorized monitor for, 18: 23966
diffraction by praseodymium, 18: 24172
diffusion equations for, computer program for solving two-group space-
18: 24572 (WAPD-TM-416)
diffusion in solids, lattice structure effects on, 18: 24577
diffusion of, computer simulation of reactor, 18: 24847 (HW-79446)
effects on A302B steel, effects of stresses on, 18: 24190(R) (GA-5037)
effects on electric and magnetic properties of gold–manganese alloys, 18: 24210
effects on graphite oxidation kinetics in acid solutions, 18: 24202(T) (GA-tr-5174)
effects on Initial Engine Test components, 18: 24937 (APEX-917)
effects on mechanical properties of austenitic stainless steels, 18: 24192 (HW-SA-3221)
effects on monkey testes, 18: 23330
effects on neutron sensors, 18: 23888 (PWAC-424)
effects on physical properties of lithium hydrides, 18: 24188 (APEX-329)
effects on pre-precipitation rate of aluminum–zinc alloys, 18: 24206

effects on preamplifier components, 18: 24822 (PWAC-427)
effects on reactor structural materials at high temperatures, 18: 24193 (HW-SA-3436)
effects on reactor pressure vessels, measurement of, 18: 23780(R) (SWRI-1243-11)
effects on sintered uranium carbide pellets, 18: 24072(T,R) (EURAEC-934)
effects on stress-strain curves of copper, strengthening theory on, 18: 24200(T) (ANL-Trans-19)
effects on survival and tumorigenesis in mice, 18: 23230(R) (ANL-6823(p.15-19))
effects on tensile properties of Zircaloy-2, 18: 24191 (HW-SA-3194)
effects on tensile properties of niobium with 0.6% zirconium, 18: 24196 (PWAC-278)
effects on thermocouples, design of apparatus for studying, 18: 23840 (RT/ING(64)-2)
effects on uranium carbides, in-pile, 18: 24860(R) (UNC-5071)
effects on work hardening of copper single crystals, 18: 24211
emission by uranium-235 fission fragments, 18: 24701
emission in helium reactions (He-3,n) with nuclei at 25 Mev, spectra of, 18: 24650
energy distributions in reactors, effects of core division by moderator material on, 18: 24849 (NP-13930(p.130))
flux distributions in reactors, activation method for determining, 18: 24840(P)
flux measurement in reactors, design of ionization chamber, 18: 24039(P)
flux measurement using foils, computer program for, 18: 23871 (ANL-6822)
flux measurements in reactors using pellet-type activation detectors, 18: 24829(P)
flux measurements at TRIGA F reactor, 18: 24957 (NDL-TR-59)
interactions with protons at 23 Mev, 18: 24625 (WASH-1046)
interactions with neutrons in final state of triton three-particle photodisintegration, 18: 24632
interactions with protons at 128 Mev, mesons (π)-nucleon coupling constants from, 18: 24423
interactions with deuterons at 2.8 to 3.6 Mev, dineutron threshold effects in, 18: 24444
interactions with neutrons at low energies, scattering length and effective range for, 18: 24451
interactions with neutrons, neutron-neutron singlet S-state scattering length in, 18: 24462
interactions with protons at 23.1 Mev, depolarization parameter for, 18: 24393 (LADC-6357)
interactions with neutrons, S-state, 18: 24398 (NP-13961)
interactions with deuterons, proton spectrum from, 18: 24398 (NP-13961)
interactions with protons, 18: 24400 (NYO-1807-9)
interactions with protons near 140 Mev, phase-shift analysis of, 18: 24403 (UCRL-7563-T)
moderation in graphite-moderated water-cooled reactors, 18: 24888 (HW-SA-3507)
pairing with protons following proton-bombardment cascade in nuclei, perturbation theory for, 18: 24664
performance for activation analysis, second-order effects on, 18: 23428
polarization in elastic and inelastic scattering on nuclei at 0.3 to 3 Mev, 18: 24694
production in proton shielding, 18: 24805 (UNC-5049)
properties in unitary symmetry model, electromagnetic, 18: 24388 (JINR-P-1616)
reactions (n,α) with boron-10 in kev range, yield ratio for ground and excited states of lithium-7 from, 18: 24620(R) (ORNL-TM-874)
reactions (n,γ) with gold-197 at 20 to 200 kev, cross sections for, 18: 24591(R) (LMSC-4-50-62-1)
reactions (n,γ) with nickel-64 at 100 to 2000 kev, cross sections for, 18: 24591(R) (LMSC-4-50-62-1)
reactions (n,γ) with nuclei, studies of nuclear structure and compound nucleus decay in, 18: 24607 (NP-13930(p.104-8))
reactions (n,f) with plutonium-241 at 2 to 100 ev, cross sections for, 18: 24586 (IDO-16976)
reactions (n,f) with plutonium-239 and uranium-233, -235, and -238, energy dependence of neutron yield from, 18: 24640
reactions (n,n′) with carbon-12 at 15 to 80 Mev, 18: 24642
reactions (N,2N) with nuclei, calculations of energy-level densities from, 18: 24596 (NP-13930(p.14))
reactions and scattering, 18: 24625 (WASH-1046)
reactions of 350-kev polarized, with oriented holmium-165, nuclear deformation and spin-spin interaction effects in, 18: 24620(R) (ORNL-TM-874)
reactions with aluminum-27, sodium-24 yields in, 18: 24592 (NP-13913)
reactions with calcium, potassium, and sodium at 8.58 to 11.59 Mev, total cross sections for, 18: 24591(R) (LMSC-4-50-62-1)
reactions with indium-115, isomeric splitting ratio of first three resonances in, 18: 24610 (NP-13930(p.114-15))
reactions with lithium for activation analysis, 18: 23427
reactions with nuclei, optical model studies of, 18: 24594 (NP-13930 (p.1-5))
reactions with nuclei at 12.5 to 19.6 Mev, cross sections for, 18: 24602 (NP-13930(p.43-9))
reactions with nuclei at 14 Mev, cross sections and gamma spectra for, 18: 24604 (NP-13930(p.54-5))
reactions with palladium at 1.2 to 10 ev, cross sections and transmission measurements for, 18: 24609 (NP-13930(p.112-13))
reactions with phosphorus pentoxide, phosphorus-32 production, 18: 24051(T) (JPRS-24590)
reactions with silicon in semiconductor detectors, 18: 24599 (NP-13930 (p.26-38))
reactions with silicon at 5 to 9 Mev, semiconductor detector studies of cross sections for, 18: 24600 (NP-13930(p.39-40))
reactions with tantalum-182 below 3.0 ev, total cross sections for, 18: 24584 (IDO-16956)
reactions with thorium-232 and uranium-238, resonance cross sections for, 18: 24673
reflection and transmission by aluminum slabs, Monte Carlo results on, 18: 24564 (BRL-1238)
reflection of, design of refractometer for, 18: 23838 (NP-13930(p.122-4))
resonances in zirconium, tin, lanthanum, and praseodymium, 18: 24620(R) (ORNL-TM-874)
scattering by defects in neutron-irradiated graphite, elastic, 18: 24207
scattering by lattice defects in cold-formed metals and irradiated materials, 18: 24194 (NP-13930(p.116-17))
scattering by nuclei, instrumentation for inelastic, 18: 24620(R) (ORNL-TM-874)
scattering by oxygen-16 at 2 to 4 Mev, resonances in elastic, 18: 24620(R) (ORNL-TM-874)
scattering by polarized nuclei at 0.3 to 14 Mev, spin-spin interactions in, 18: 24645
scattering by sodium-23 at 0 to 4 Mev, nuclear model calculations of, 18: 24597 (NP-13930(p.15))
scattering by vanadium and vanadium hydride, spectra from inelastic, 18: 24605 (NP-13930(p.59-71))
scattering law for, 18: 24625 (WASH-1046)
separation energies in even A-$(84 \leq N \geq 98)$ nuclei, 18: 24681
thermalization by isopropyl bipheny and water, 18: 24566 (NP-13921)
transmission by lead and tungsten, resonance parameters from, 18: 24620(R) (ORNL-TM-874)
transmission by tin isotopes, nuclear radii from, 18: 24620(R) (ORNL-TM-874)
transport equation for, anisotropic scattering effects in, 18: 24565 (LA-3051)
transport equations for monoenergetic, variational boundary conditions for spherical harmonics approximation to, 18: 24573
yields from proton reactions (p,n) with vanadium-51 at 1.6 to 2.2 Mev, 18: 24591(R) (LMSC-4-50-62-1)

NEUTRONS, COLD
production by total reflection, 18: 24569 (NP-13930(p.119-20))

NEUTRONS, DELAYED
yields in electron bombardment of uranium at 8 to 13 Mev, 18: 24574

NEUTRONS, FAST
cross sections for, total, 18: 24625 (WASH-1046)
detection and measurement using threshold detectors, 18: 23885 (NP-13930(p.178-80))
detection and measurement using boron trifluoride counter in hollow paraffin sphere, 18: 23900
detection and measurement of 14-Mev, semiconductor counter telescope

for, 18: 23985
detection and measurement using lithium-6 semiconductor counter telescope, 18: 23986
detection and measurement in gamma background, transistorized pulse-shape discriminator for, 18: 23994
detection using plastic scintillator, computer program for calculating efficiency of, 18: 23891 (UCRL-11339)
dose rate measurements within and behind beryllium oxide, 18: 24806 (XDC-61-1-149)
dosimetry by phosphorus-32 activation, 18: 23890 (SCPRI(S)-92)
dosimetry of, sources of errors in, in use of nuclear emulsions for, 18: 23961
effect on strain and stress distributions in fuel elements, 18: 24943
effects on copper–nickel alloys, redistribution kinetics of segregated zones from, 18: 24208
effects on ESR spectra of pure zinc sulfide, 18: 23664
effects on excitation spectra of copper-activated and pure zinc sulfides, 18: 24575
effects on rat lifespan, effects of irradiation age on, 18: 23292
effects on zinc sulfide, phase transitions induced by, 18: 23665
energy spectra of, determination by proton spectra measurements from neutron scattering on polyethylene films, 18: 23883 (NP-13930(p.147-57))
ionization by, in nuclear plasma diodes, 18: 24373
multiplication factor for, in thermal reactors, 18: 24846 (EUR-1618.e)
reactions (n,α) with nitrogen-14 and oxygen-16, cross sections, 18: 24643
reactions (n,γ) with copper and manganese, gamma spectra from, 18: 24699
reactions (n,n′γ) and (n,2n) with carbon at 14 Mev, spectrometry of angular distributions from, 18: 24603 (NP-13930(p.51-3))
reactions with nuclei at 14 Mev, systematics of cross sections for, 18: 24601 (NP-13930(p.41-2))
reactions with thorium-232, nuclear emulsion for analysis of fission, 18: 23959
scattering resonances in fast reactors, computer program for, 18: 24811 (ANL-6805)
spectroscopy of, emulsion and junction detectors for, 18: 23960
thermalization in paraffin, from 15.9 Mev, 18: 24578
NEUTRONS, FISSION
angular distributions and energy spectra of, from thermal neutron fission of uranium-235, 18: 24697
slowing-down spectra in beryllium and beryllium oxide, 18: 24576
NEUTRONS, PROMPT
emission in californium-252 spontaneous fission, statistics of, 18: 24651
NEUTRONS, RESONANCE
capture and transmission by iron, lead, and sulfur, 18: 24620(R) (ORNL-TM-874)
capture by hafnium and tungsten isotopes at 30 to 1200 ev, 18: 24571(R) (RPI-328-6)
NEUTRONS, THERMAL
capture by nuclei, resonance scattering and absorption of gamma rays from, 18: 24620(R) (ORNL-TM-874)
capture by nuclei, research program using FRM on, 18: 24961 (NP-13930(p.80-103))
detection and measurement in reactors, digital techniques for, 18: 24004
diffusion in polythene, extrapolation lengths for, 18: 24571(R) (RPI-328-6)
dosimetry by phosphorus-32 activation, 18: 23890 (SCPRI(S)-92)
flux buckling in plutonium-graphite assemblies, 18: 24852
flux distribution measurements within and behind beryllium oxide, 18: 24806 (XDC-61-1-149)
flux mapping of, using semiconductor detectors and tunnel diodes, 18: 24827
flux measurements using gold foil activation, 18: 23876 (KFK-180)
flux measurements using indium and silver nitrates and rhodium sulfate, 18: 23896
reactions (n,γ) with copper and manganese, gamma spectra from, 18: 24699
reactions (n,f) with uranium-235, yields for, 18: 24677
reactions (n,f) with uranium-235, neutron emission by fission fragments in, 18: 24701
reactions with boron and uranium-235, cross sections, 18: 24578
reactions with uranium-235, angular distributions and energy spectra of neutrons emitted in, 18: 24697
scattering by hydrogenous compounds, 18: 24625 (WASH-1046)
scattering by polarized nuclei in ferromagnetic materials, 18: 24580
scattering by polythene, distributions from, 18: 24571(R) (RPI-328-6)
scattering by rotating states in molecules, 18: 24299 (NP-13930 (p.56-7))
scattering lengths of, comparison of coherent, 18: 23878 (NP-13930 (p.76-7))
NEVADA TEST SITE
effects of large underground Sedan explosion on lizard population, 18: 23181 (UCLA-12-522)
NICKEL
coating with radioactive rare earth for use as radiation source, 18: 2405
corrosion of welds of, by gases, 18: 24813(R) (ANL-6880(p.49-67))
corrosion resistance of plating of, on aluminum in aqueous systems at 300 and 330°C, 18: 24083 (HW-81196)
creep of, effects of stress and temperature on, 18: 24136 (NP-13909)
crystal structure and magnetic properties of plating of, on aluminum, 18: 24083 (HW-81196)
determination in small solid samples by mass spectroscopy, design of ion source for, 18: 23406 (CONF-512-4)
determination in thorium at 50 to 500 ppm, spectrophotometric, 18: 2341 (Y-1464)
effects on beryllium crystals, 18: 24066(R) (NMI-2126)
effects on beryllium crystals, 18: 24067(R) (NMI-2127)
effects on phase transformations in steel, 18: 24152(T,R) (EURAEC-1001)
emissivity of coated, in vacuum, 18: 24138(R) (PWA-2206(Vol.I))
emissivity of coated, in vacuum, 18: 24139(R) (PWA-2206(Vol.II))
emissivity of coated, in vacuum, 18: 24140(R) (PWA-2206(Vol.III))
ion reactions at 36 to 115.5 Mev, dissociation in, 18: 24723
neon-20 reactions at 130 Mev, production of proton emitters in, 18: 24737
neutron capture gamma spectra, 18: 24625 (WASH-1046)
phonon spectra, 18: 24959 (NP-13910)
separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)
sorption of americium-241 and protactinium-233 by, from water–ethanol solutions, 18: 23724
sorptive properties for hydrogen and hydroxyl ions, 18: 23448 (PAN-466/V)
welding of, Hanford guide to procedures, specifications, and qualification test records for, 18: 24104 (TID-20625(Vol.III))
wetting by molten chlorides and fluorides, sessile drop observations, 18: 23437 (CONF-322-12)
NICKEL ALLOYS
emissivity of coated Nichrome in vacuum, 18: 24139(R) (PWA-2206 (Vol.II))
emissivity of coated Nichrome in vacuum, 18: 24140(R) (PWA-2206 (Vol.III))
emissivity of coated Nichrome in vacuum, 18: 24138(R) (PWA-2206 (Vol.I))
performance of Incoloy 804 in nuclear superheater environment, 18: 24886(R) (GEAP-4565)
radiation effects on mechanical properties and microstructure of, at 50 to 650°C, 18: 24193 (HW-SA-3436)
welding of, Hanford guide to procedures, specifications, and qualification test records for, 18: 24104 (TID-20625(Vol.III))
Ce–Ni, phase studies, 18: 24815(R) (MLM-1184)
Ce–Ni–Pu, phase studies, 18: 24815(R) (MLM-1184)
Cr–Cu–Fe–Mo–Ni, performance of Ni–O–Nel 825 in nuclear superheater environment, 18: 24886(R) (GEAP-4565)
Cr–Fe–Ni, performance of Incoloy, Incoloy 800, Incoloy 801, and Ni–O–Nel in nuclear superheater environment, 18: 24886(R) (GEAP-4565)
Cr–Fe–Ni, performance of Incoloy, Incoloy 800, Ni–O–Nel, and RA 330 in nuclear superheater environment, 18: 24884(R) (GEAP-4419)
Cr–Ni, creep and corrosion tests on fuel sheets of, 18: 24939(R) (GEAP-285)
Cu–Ni, radioinduced segregation in, rehomogenization kinetics of fast-

neutron, 18: 24208
Fe–Ni, effects of alloying on strength of, 18: 24161
Fe–Ni, physical properties of, effects of molybdenum admixtures on, 18: 24159
Ni–Nb–W, solid state bonding of, 24112
Ni–W, solid-state bonding of, 18: 24112
Ni–Zr, corrosion by steam at 400°C, 18: 24150(T,R) (EURAEC-538)
Ni–Zr, phase studies and properties of extruded, effects of annealing, quenching, and tempering on, 18: 24150(T,R) (EURAEC-538)
NICKEL COUPLES
Mo–Ni/Ti, solid state bonding of, 18: 24112
NICKEL ISOTOPES
deuteron reactions (d,p) with, angular distribution from, 18: 24625 (WASH-1046)
electron inelastic scattering by, form factors for magnetic dipole, 18: 24625 (WASH-1046)
NICKEL ISOTOPES Ni-57
gamma spectra, 18: 24585(R) (IDO-16969)
NICKEL ISOTOPES Ni-58
alpha scattering at 43 Mev, interference effects in, 18: 24713
helium-3 reactions at 22 Mev, deuteron angular distributions in, 18: 24590 (LADC-6370)
neutron reactions (n,p) with, for neutron flux measurements, 18: 23885 (NP-13930(p.178-80))
NICKEL ISOTOPES Ni-60
helium-3 reactions at 22 Mev, deuteron angular distributions in, 18: 24590 (LADC-6370)
NICKEL ISOTOPES Ni-61
neutron capture cross sections, 18: 24620(R) (ORNL-TM-874)
NICKEL ISOTOPES Ni-62
neutron capture cross sections, 18: 24620(R) (ORNL-TM-874)
NICKEL ISOTOPES Ni-64
neutron capture cross sections, 18: 24620(R) (ORNL-TM-874)
neutron capture cross section at 0.12 to 1.96 Mev, 18: 24625 (WASH-1046)
neutron radiative capture cross sections at 100 to 2000 kev, 18: 24591(R) (LMSC-4-50-62-1)
NICKEL ISOTOPES Ni-65
decay of, beta and gamma spectra from, 18: 24639
NICKEL OXIDES
spectra in low frequency region, infrared, 18: 23549
NICKEL STEEL
ductility of, effects of hydrogen on, 18: 24153(T,R) (EURAEC-1002)
NIOBIUM
alloying effects on iron–nickel alloys, 18: 24161
brazing to aluminum oxides in thermionic diodes, 18: 24368 (JPL-TR-32-548)
effects on hydrogen embrittlement of steel, 18: 24153(T,R) (EURAEC-1002)
effects on oxidation resistance of graphite, 18: 24087 (WADD-TR-61-72(Vol.XXX))
effects on phase transformations in steel, 18: 24152(T,R) (EURAEC-1001)
emissivity of coated, in vacuum, 18: 24138(R) (PWA-2206(Vol.I))
emissivity of coated, in vacuum, 18: 24139(R) (PWA-2206(Vol.II))
emissivity of coated, in vacuum, 18: 24140(R) (PWA-2206(Vol.III))
melting of, effects of additives, arc current, and electrode density on vacuum-arc, 18: 24070 (RTD-TDR-63-4089)
neutron scattering by, optical model analysis of, 18: 24625 (WASH-1046)
performance as fuel cladding in fast reactors, 18: 24952(R) (ANL-6880(p.6-48))
poisoning by, effects on kidney function in rats, 18: 23203 (UR-646)
radiation damage to tensile properties of, effects of annealing and of zirconium on, 18: 24196 (PWAC-278)
separation from protactinium and zirconium by solvent extraction using benzoylphenylhydroxylamine, 18: 23728
welding of, electron-beam and vacuum arc, 18: 24108
NIOBIUM ALLOYS
corrosion by steam at 540 and 650°C, 18: 24080 (BMI-X-286)
radiation effects on mechanical properties and microstructure of, at 50°C, 18: 24193 (HW-SA-3436)
Cr–Nb, electric and mechanical properties, 18: 24158
Cr–Nb–Ti–V, properties for use as cladding materials in nuclear superheat applications, 18: 24080 (BMI-X-286)
Ir–Nb, electric and mechanical properties, 18: 24158
La–Nb, electric and mechanical properties, 18: 24158
Mo–Nb, electric and mechanical properties, 18: 24158
Mo–Nb, hydrogen affinity of, 18: 24165
Mo–Nb, solid-state bonding of, 18: 24112
Mo–Nb–V–Zr, fabrication and properties of coated B-66, 18: 24068(R) (NP-13955)
Mo–Nb–V–Zr, fabrication of extruded B-66, 18: 24093(R) (AD-424593)
Mo–Nb–W, factors affecting vacuum-arc melting of, 18: 24070 (RTD-TDR-63-4089)
Nb–Pd, electric and mechanical properties, 18: 24158
Nb–Re, electric and mechanical properties, 18: 24158
Nb–Re, hydrogen affinity of, 18: 24165
Nb–Re–W, factors affecting vacuum-arc melting of, 18: 24070 (RTD-TDR-63-4089)
Nb–Sn, superconducting magnets of, 18: 24547
Nb–Ta, electric and mechanical properties, 18: 24158
Nb–Ta–W–Zr, fabrication and properties of forged and rolled FS-85, 18: 24093(R) (AD-424593)
Nb–Ti, bulk superconductivity in, 18: 24553
Nb–Ti, electric and mechanical properties, 18: 24158
Nb–U, phase transformations in, 18: 24124 (CEA-2341)
Nb–W, electric and mechanical properties, 18: 24158
Nb–W, factors affecting vacuum-arc melting of, 18: 24070 (RTD-TDR-63-4089)
Nb–W, solid-state bonding of, 18: 24112
Nb–W–Zr, fabrication and properties of coated D-43, 18: 24068(R) (NP-13955)
Nb–Zr, corrosion by potassium at 2000 to 2200°F, 18: 24091
Nb–Zr, emissivity of coated, in vacuum, 18: 24138(R) (PWA-2206 (Vol.I))
Nb–Zr, emissivity of coated, in vacuum, 18: 24139(R) (PWA-2206 (Vol.II))
Nb–Zr, emissivity of coated, in vacuum, 18: 24140(R) (PWA-2206 (Vol.III))
Nb–Zr, performance as cladding for uranium carbide fuels, 18: 23817(R) (ANL-6880(p.72-8))
Nb–Zr, performance as fuel cladding in fast reactors, 18: 24952(R) (ANL-6880(p.6-48))
Nb–Zr, performance as cladding for uranium carbide fuels, 18: 24860(R) (UNC-5071)
Nb–Zr, superconducting magnets of, 18: 24547
Ni–Nb–W, solid state bonding of, 18: 24112
Zr–Nb, electric and mechanical properties, 18: 24158
NIOBIUM CARBIDES
electric properties of, rigid band model for interpreting, 18: 24137 (NP-13944)
thermodynamic properties at 298.15 to 2000°K, 18: 23435 (BM-RI-6446)
NIOBIUM ISOTOPES Nb-93
neutron capture resonances in, parameters of, 18: 24625 (WASH-1046)
NIOBIUM ISOTOPES Nb-95
content in Swedish food, 1962, 18: 23790 (NP-13828)
deposition on stainless steel in fuel element processing, 18: 23705 (ORNL-TM-837)
radioactivity standardization in mixtures with zirconium-95, 18: 24042 (AERE-R-4555)
separation by calcium phosphate–humic acid flocculation, 18: 24982
NIOBIUM NITRIDES
electric properties of, rigid band model for interpreting, 18: 24137 (NP-13944)
NIOBIUM OXIDES
spectra in low frequency region, infrared, 18: 23549
NIOBIUM SYSTEMS
B–Nb, electric and mechanical properties, 18: 24158
C–Mo–Nb–W–Zr, corrosion by potassium at 2000 to 2200°F, 18: 24091
C–Nb–W–Y–Zr, corrosion by potassium at 2000 to 2200°F, 18: 24091
Nb–Si, electric and mechanical properties, 18: 24158
NITRAMIDES
combustion and thermal decomposition processes in, mechanism of, 18: 25027(T) (LA-tr-64-2)
NITRATE IONS

determination in beryllium solutions by cation exchange, 18: 23423

NITRIC ACID
- diffusion into polymers, 18: 25022(T) (ANL-Trans-15)
- nitrogen-15 NMR in, chemical shifts in, 18: 23530
- reactions with trioctylamine, isotope effects in, 18: 23576
- separation from uranyl chloride and nitrate by solvent extraction using dioctyl sulfoxide, 18: 23716
- solubility in tributyl phosphate at 25°C, 18: 23712
- HNO_3–TBP, solvent properties for californium, europium, fermium, and mendelevium, 18: 23725

NITRIDES
- book: *High-Temperature Materials.* No. 1, *Materials Index,* 18: 24075

NITROGEN
- determination in superheated steam, design of gas chromatograph for, 18: 23407 (DP-880)
- deuterium and deuteron reactions at 20 Mev, electron detachment in, 18: 24310
- effects on corrosion of Zircaloy-2, 18: 24081 (CONF-509-1)
- effects on dynamic decomposition of rare earth oxalates, 18: 23507
- hydrogen ion reactions at 10 to 180 kev, dissociation in, 18: 24324
- meson (π^-) reactions at 7.5 Bev, 18: 24390 (JINR-P-1624)
- meson (π^-) reactions at 7 Bev, 18: 24391 (JINR-P-1629)
- properties of, behind shock waves, 18: 24235
- radioinduced nitrogen-14 and -15 isotopic exchange in gaseous, mechanism of, 18: 23680
- temperature behind reflected shock waves, 18: 24236
- thermodynamic properties of plasma of, 18: 24742 (ANL-6802(p.15-18))
- use as carrier gas in radon sorption studies on wood charcoal, 18: 23462(T) (SC-T-64-616)

NITROGEN ISOTOPES N-14
- helium reactions (He-3,n) at 25 Mev, spectra of, 18: 24650
- neutron reactions (n,2n) at 12.5 to 19.6 Mev, cross sections for, 18: 24602 (NP-13930(p.43-9))
- neutron reactions (n,α) with, cross sections for fast, 18: 24643
- nitrogen-14 reactions with, analysis of, 18: 24618 (NYO-1807-8)
- radioinduced isotopic exchange with nitrogen-15 in gaseous nitrogen, mechanism of, 18: 23680
- reactions (N-14,α) with nuclei at 27 Mev, angular momentum effects in, 18: 24726
- reactions with light nuclei at 9.6 Mev, gamma spectra of transfer, 18: 24721
- reactions with nuclei at 27.5 Mev, single-nucleon transfer excitation functions for, 18: 24716
- reactions with rare earths, effective charge distribution from, 18: 24624 (UCRL-10806)
- scattering by carbon-12 and nitrogen-14, cross sections for elastic, 18: 24674

NITROGEN ISOTOPES N-15
- emission in oxygen reactions (O-16,N-15) with aluminum-27 at 30 Mev, angular distributions for, 18: 24718
- energy levels, 18: 24625 (WASH-1046)
- neutron total cross sections of, fast, 18: 24625 (WASH-1046)
- nuclear magnetic resonance in compounds, chemical shifts in, 18: 23530
- radioinduced isotopic exchange with nitrogen-14 in gaseous nitrogen, mechanism of, 18: 23680

NITROGEN OXIDES
- determination in superheated steam, design of gas chromatograph for, 18: 23407 (DP-880)
- effects on radioinduced isomerization of 2-butene, 18: 23666
- hydrated electron reactions with, rate constants for, 18: 23691
- radioinduced reactions with Teflon, electron spin resonance studies of, 18: 23648(T,R) (AEC-tr-6316(p.534-7))
- radioinduced reactions with acrylamide and methacrylamide monomers and polymers, 18: 23650(T,R) (AEC-tr-6316(p.567-72))

NITROGEN SYSTEMS
- Ar–N, nitridation of uranium–zirconium droplets in, 18: 24933 (AFSWC-TDR-63-51)
- F–N, corrosive effects on nickel having weldments, 18: 24813(R) (ANL-6880(p.49-67))
- HCl–N, corrosive effects on nickel having weldments, 18: 24813(R) (ANL-6880(p.49-67))
- N–O, corrosive effects on nickel having weldments, 18: 24813(R) (ANL-6880(p.49-67))
- N–O, radiation effects on optical spectra of, electron, 18: 24300(R) (NP-13953)

NOISE
- removal of space-charge fast-wave, using resonators, 18: 23848

NORLEUCINE
- synthesis and transformation in uv photolysis of organic compounds in mixtures with ammonium compounds, 18: 23204(T) (JPRS-24164 (p.19-42))

NORVALINE
- synthesis and transformation in uv photolysis of organic compounds in mixtures with ammonium compounds, 18: 23204(T) (JPRS-24164 (p.19-42))

NUCLEAR AIRCRAFT POWER PLANTS
- control system for, analysis of, 18: 24935 (APEX-260)
- criticality studies on P127 offset twin-engine design mockup, 18: 24845 (APEX-638)

NUCLEAR BATTERIES
- design of alpha-emitting heat source, 18: 24049(P)
- development for space propulsion systems, 18: 24358 (ANL-6802 (p.89-99))
- development of fission-electric cells, 18: 24372(R) (TID-20575)
- development of thermoelectric, for space uses, 18: 24351(R) (AD-427285)

NUCLEAR EMULSIONS
- aging effects in ultra-fine, 18: 23918
- alpha reactions at 900 Mev, 18: 24619 (NYO-10269)
- analysis of double-star short-range hyperfragments in, method for, 18: 24445
- analysis of multiple scattering and track curvature in, device for, 18: 24003
- charged particle reactions with electrons in, 18: 23908
- developing of, changes in alpha and electron tracks during, 18: 23924
- development by electrodialysis, 18: 23927
- development of exposed, aboard satellites, 18: 23957
- development of unsupported layers of, wet-method, 18: 23926
- development techniques for maximum track visibility in, 18: 23937
- development techniques for, after exposure in space probes, 18: 23956
- discrimination between gamma and particle tracks in, 18: 23912
- discrimination between gamma background and protons in, 18: 23929
- discrimination between alpha particles and protons in, using super-proportional intensification, 18: 23931
- discrimination between alpha particles and protons in, 18: 23932
- discrimination between alpha particles and protons in, 18: 23933
- discrimination between low-energy deuterons and protons in, 18: 23943
- distortion during development of, reduction of, 18: 23556
- granulation curves and sensitivities of, 18: 23909
- heavy ion discrimination in, 18: 23954
- image etching in, in stop-bath, 18: 23928
- images on, photometric analysis of, 18: 23914
- impregnation with uranium salts, 18: 23553
- ion beam reactions with, effects of energy and mass on grain darkening in, 18: 23916
- latent image eradication in, for low-intensity radiation detection, 18: 23921
- meson (K⁻) reactions in, nonmesic hyperfragment production in, 18: 24
- meson (K⁻) reactions in, hyperon (Σ) production in, 18: 24415
- meson (π^-) absorption by nuclei in Ilford G-5, 18: 24582 (AD-439331)
- meson (π^-) elastic single scattering in, detection of, 18: 23947
- moving plates of, instrument for, 18: 23847
- particle momentum determinations in, at high energies, 18: 23945
- particle track analysis in, microscope for, 18: 23940
- particle track analysis in, semi-automatic methods for, 18: 23941
- particle tracks in, effects of development parameters on spurious, 18: 23935
- particle tracks in, analysis of spurious, 18: 23936
- performance as detectors on sounding rockets, 18: 23955
- performance for analyzing fast-neutron fission of thorium-232, 18: 23959
- performance for discriminating between high-energy particles, 18: 23911
- performance for fast-neutron spectroscopy, 18: 23960
- performance for measuring alpha distributions from proton collisions with nuclei, 18: 23948

performance for nuclear-reaction studies at accelerators, 18: 24261
performance for nuclear fission studies, 18: 23958
performance in 48-kOe magnetic fields, 18: 23946
performance of tungsten-loaded, 18: 23920
photographic properties and grain formation, 18: 23490
photographic properties of, effects of moisture on stability of, 18: 23922
preparation and processing of ionographic, 18: 23496
preparation and properties of fine-grained, 18: 23498
preparation by ammonia maturing, grain growth in, 18: 23493
preparation by continuous reaction of silver nitrate, potassium bromide, and gelatin in 1 ml mixer, 18: 23494
preparation by Ostwald maturing, 18: 23492
preparation for use in electron microscopy, 18: 23845
preparation of Mylar-supported thin sheets of, 18: 23925
preparation of, having sensitivity varying with dose, 18: 23923
properties and uses of, review, 18: 23905
properties of lithium-acetate-loaded, 18: 23919
properties of, effects of preparation method on, 18: 23489
properties of, effects of sodium salts of sulfosuccinic acid esters as surface-active agents on, 18: 23495
range-energy relations of boron-11 and carbon-13 in, 18: 24643
scanning of bubble-chamber, device for ionization measurements in, 18: 24002
scanning of, statistical methods in, 18: 23944
sensitivities to charged particles and light photons, 18: 23910
sensitivity centers in, sizes and structures of, 18: 23913
sensitivity of, effects of ripening processes on, 18: 23497
sensitization by iron sulfates and triethanolamine, 18: 23550
sensitization mechanisms in layers of, 18: 23551
sensitization of, using dyestuffs, 18: 23499
swelling during preparation of, methods of measuring and reducing, 18: 23555
track analysis in, electronic instruments for, 18: 23939
track analysis in, automatic devices for, 18: 23942
track analysis in, working accuracies for, 18: 23949
track distortion in, effects of guard rings on, 18: 23938
tracks in, blob distributions in relativistic, 18: 23953
tracks in, discrimination between alpha and bremsstrahlung, 18: 23930
tracks in, distortions and spurious scatterings in, 18: 23950
tracks in, distortions and spurious scatterings in, 18: 23951
tracks in, in relativistic ionization-loss region, 18: 23952
tracks of multiply scattered particles in, spurious effects in, 18: 23934
uses in neutron dose measurements for personnel, sources of error in, 18: 23961

NUCLEAR ENGINEERING
index to conferences on, 1957 through 1963, 18: 25005 (TID-4043 (Rev.1))

NUCLEAR ISOMERS
lifetimes of ultra-shortlived, measurement using semiconductor detectors, 18: 24025

NUCLEAR MAGNETIC RESONANCE
book: *Nuclear Orientation*, a collection of reprints, 18: 24706
burnup analysis of reactor fuels, 18: 24856(R) (GEAP-4430)
Kronig-Kramers relations in, 18: 24659
quantum transition enhancement in, method for double, 18: 24644
spectroscopy, review on long-range H^1–H^1 spin-spin coupling in, 18: 24234

NUCLEAR MATERIALS MANAGEMENT
economics of plutonium, thorium, and uranium fueled reactors, 18: 24858(R) (HW-80560F)
economics of uranium enrichment by gaseous diffusion, 18: 24054(T) (ORNL-tr-134)
fuel cycles in organic-moderated reactors, 18: 24859 (TID-20593)
in analysis methods, ORNL Master Analytical Manual, 18: 23410 (TID-7015(Suppl.6))
reactor fuel cost reduction, 18: 24866
tritium disposal in fuel processing wastes, 18: 24978 (ORNL-TM-851)

NUCLEAR MODELS
alpha scattering on complex nuclei in smooth cutoff, analysis of, 18: 24712
californium-252 spontaneous fission prompt neutron statistics from, 18: 24651
deformations in pairing-plus-quadrupole, j-shell, 18: 24614 (NP-13941)
statistical, development of, 18: 24633

NUCLEAR MODELS (COLLECTIVE)
use in calculating neutron scattering on sodium-23 at 0 to 4 Mev, 18: 24597 (NP-13930(p.15))

NUCLEAR MODELS (DROP)
configurations of rotating, with high angular momentum, 18: 24733

NUCLEAR MODELS (OPTICAL)
alpha scattering on complex nuclei, analysis of, 18: 24712
evaluation for neutron reaction studies, 18: 24594 (NP-13930(p.1-5))
use for calculating transmission coefficients and absorption cross sections for neutrons and protons, 18: 24595 (NP-13930(p.6-13))
use in calculating neutron scattering on sodium-23 to 0 to 4 Mev, 18: 24597 (NP-13930(p.15))

NUCLEAR MODELS (SHELL)
alpha cluster reduced widths in light nuclei, 18: 24588 (JINR-P-1595)
fluorine-18 even-parity levels in, 18: 24685
Green's functions in classical, 18: 24615 (NP-13959)
nucleon grouping in shell-model states, fractional parentage coefficients for three-particle, 18: 24621 (PAN-449/VII)
oxygen-16 odd-parity levels from, 18: 24649
oxygen-18 even-parity levels in, 18: 24685
potassium-40 energy levels from, 18: 24634

NUCLEAR PHYSICS
book: *Nuclear Orientation*, a collection of reprints, 18: 24706
conference on neutron physics, Karlsruhe, Germany, Oct. 8 to 10, 1963, 18: 24567 (NP-13930)
data processing in, 18: 23849
data representation, 18: 24987 (AEEW-M-426)
multiparametric analyses in, use of integral computer for, 18: 24063
research program, 18: 24959 (NP-13910)

NUCLEAR POWER
future prospects for Portugal, 18: 24922

NUCLEAR POWER PLANTS
design and development of Latina, 18: 24923
design for thermoelectric, for underwater applications, 18: 24903 (NP-13900(Sect.10))
design of phosphorus sulfide-cooled thermoelectric, conceptual, 18: 24902 (NP-13900(Sect.9))
design of thermionic, 18: 24927
development of thermoelectric, for space uses, 18: 24351(R) (AD-427285)
development of thermionic, summary, 18: 24369(R) (NP-13892)
fuel elements for lunar, mechanical analysis of, 18: 24943
radiator design for space, 18: 23779

NUCLEAR REACTIONS
analysis of nucleon transfer, 18: 24618 (NYO-1807-8)
conference on complex nuclei, 18: 24707
detection and measurement of high-energy, using emulsions, 18: 23905
detection of (γ,α), in nuclear emulsion, 18: 23930
distorted-wave theory of stripping, finite-range effects in, 18: 24667
optical-model evaluation of neutron-produced, 18: 24594 (NP-13930 (p.1-5))
systematics of effective cross sections of neutron-produced, in the medium-energy region, 18: 24601 (NP-13930(p.41-2))
theory of compound nucleus, high angular momentum states in, 18: 24733
use of (n,γ), for nuclear physics studies, 18: 24607 (NP-13930(p.104-8))

NUCLEAR SPIN
book: *Nuclear Orientation*, a collection of reprints, 18: 24706

NUCLEAR STRUCTURE
nucleon grouping in shell-model states, fractional parentage coefficients for three-particle, 18: 24621 (PAN-449/VII)
pairing correlations in deformed nuclei, 18: 24692
pairing correlations in nuclear surface layer, 18: 24630
theory, 18: 24684

NUCLEAR THEORY
book: *Nuclear Orientation*, a collection of reprints, 18: 24706
Coulomb excitation in deformed nuclei, 18: 24641
coupling between shell model excitations and cluster excitations in light nuclei, 18: 24588 (JINR-P-1595)
determination of nuclear matrix elements for forbidden transitions from ratio of electron capture to positron emission, 18: 24629

effects of finite nuclear dimensions on unique first-forbidden transitions, 18: 24638
Green's functions in classical, 18: 24615 (NP-13959)
ground-state energy of odd-fermion systems in, 18: 24631
higher-order spacing distributions for a class of unitary ensembles, 18: 24679
lectures, 18: 24593 (NP-13925)
nucleon grouping in shell-model states, fractional parentage coefficients for three-particle, 18: 24621 (PAN-449/VII)
nucleon tunneling, applicability of, 18: 24617 (NYO-1807-7)
pairing correlations in deformed nuclei, 18: 24692
pairing correlations in nuclear surface layer, 18: 24630

NUCLEI
book: *Nuclear Orientation*, a collection of reprints, 18: 24706
decay of, spin relaxation in gamma angular correlations of, 18: 24653
decay of, three-body, 18: 24625 (WASH-1046)
deformation in even-A (84≤N≥98), mass effect associated with, 18: 24681
deformation of j-shell of, in pairing-plus-quadrupole model, 18: 24614 (NP-13941)
deuteron stripping reactions with, inelastic effects in, 18: 24652
electron inelastic scattering by, partial-wave analysis of, 18: 24669
electron scattering by coulomb fields of, double bremsstrahlung in, 18: 24704
energy level Coulomb excitation in deformed, theory of, 18: 24641
energy level transitions in light, form factors for strong M1, 18: 24675
energy level transitions in light, form factors for M1, 18: 24676
energy levels of complex, statistical higher-order spacing distributions for hamiltonian unitary ensembles of, 18: 24679
energy levels of deformed, multiple coulomb excitation of, 18: 24728
energy levels of odd, BCS determination of ground-state, 18: 24631
energy levels of, methods for calculating densities of, 18: 24596 (NP-13930(p.14))
energy levels of, statistics of intervals and widths of, 18: 24598 (NP-13930(p.17-25))
energy levels of, symmetrization in coulomb excitation of, 18: 24731
fission of, analysis using nuclear emulsions, 18: 23958
ion scattering by, reorientation effect in, 18: 24625 (WASH-1046)
meson (K^-) reactions with, hyperon (Σ) production in, 18: 24415
meson (μ) capture by heavy, theory of, 18: 24658
meson (π^-) absorption by emulsion, 18: 24582 (AD-439331)
neutrino reactions in universe, theory of, 18: 24348
neutron and proton absorption cross sections and transmission coefficients, optical model calculations of, 18: 24595 (NP-13930(p.6-13))
neutron reactions with, optical studies of, 18: 24594 (NP-13930(p.1-5))
neutron reactions at 14 Mev, systematics of cross sections for, 18: 24601 (NP-13930(p.41-2))
neutron reactions at 14.7 Mev, activation cross section measurements in, 18: 24613 (NP-13930(p.139))
neutron reactions (n,γ) with, studies of compound nucleus decay and nuclear structure in, 18: 24607 (NP-13930(p.104-8))
neutron scattering by polarized, in ferromagnetic materials, 18: 24580
neutron separation energies in even-A (84≤N≥98), 18: 24681
nucleon density distribution in, effects of exponential, Gaussian, and Yukawaian interactions on, 18: 24633
nucleon tunneling in, theory for, 18: 24617 (NYO-1807-7)
orientation of, deformation cooling for, 18: 24703
pairing correlations between like nucleons in strongly deformed, 18: 24692
pairing correlations in surface layer of, 18: 24630
production of delayed-proton emitting, possibility of, 18: 24736
production of proton-emitting, 18: 24737
production of 4- and 6-neutron, in calcium-48 reactions, 18: 24616 (NP-13964)
proton elastic scattering by complex, polarization in, 18: 24625 (WASH-1046)
reactions between complex, conference on, 18: 24707
reactions of complex, delayed proton emission in, 18: 24736
scattering by nuclei, long-range interaction potential in elastic, 18: 24674
scattering of spin-½ particles by, strong-absorption model for polarization in elastic, 18: 24636
wave functions for low-energy particles in, coulomb, 18: 24682

NUCLEI (CELLS)
nucleoplasm stratification in Pelomyxa, by centrifugation, 18: 23197(R) (ANL-6823(p.169-73))
radiation effects on amino acid incorporation by proteins of rat thym 18: 23259
soluble proteins in rat liver, factors affecting, 18: 23192(R) (ANL-6823(p.124-7))

NUCLEIC ACIDS
protective effects against radioinduced leukopenia in rabbits, 18: 23

NUCLEONS
binding energies in oxygen-16, 18: 24635
coupling constant of, with mesons, 18: 24411
emission in neon-20 reactions with tantalum at 160 Mev, 18: 24717
exchange in nitrogen-14 reactions with nuclei at 27.5 Mev, excitatio functions for, 18: 24716
grouping in shell-model states, fractional parentage coefficients for th particle, 18: 24621 (PAN-449/VII)
interactions in nuclei, density distributions from exponential, Gaussia and Yukawaian, 18: 24633
interactions with mesons (π), single-meson exchange in, 18: 24477
interactions with nucleons, single-meson exchange in, 18: 24477
interactions with nucleons meson (π) production in resonant, 18: 24
interactions with antinucleons, optical model for, 18: 24481
interactions with leptons, scattering amplitudes for, 18: 24419
interactions with mesons (π), coupling constants for, 18: 24423
interactions with antinucleons and nucleons, analysis of total cross sections including channel-crossing for, 18: 24452
interactions with mesons (π^+) meson (f^0) spin from, 18: 24466
interactions with antinucleons, meson (π) form factors from, 18: 24
interactions with mesons, phase-shift linearization of differential cross sections for, 18: 24472
interactions with mesons (π), mechanisms of low-energy, 18: 24474
interactions with mesons (π^-) at 7 Bev, 18: 24391 (JINR-P-1629)
interactions with meson (π^-), parity conservation in hyperon (Λ^0) produc tion in, 18: 24394 (NEVIS-122)
interactions with nucleons near 140 Mev, phase-shift analysis of, 18: 24403 (UCRL-7563-T)
interactions with antinucleons and mesons (K) and (π) at high energie parameters for, 18: 24384 (JINR-P-1577)
interactions with nucleons at high energies, parameters for, 18: 2438 (JINR-P-1577)
interactions with mesons (π), constants and coupling in shell-model, 18: 24414
meson (π^-) capture by, in propane, 18: 24475
pairing correlations in deformed nuclei, 18: 24692
production in meson (π) reactions with beryllium-9, cross sections f 18: 24587 (JINR-P-1584)
resonance (N^* and Y^*) production model, 18: 24456
resonance (πN) at 1350 Mev, possible existence of J = ⅝, 18: 2445
transfer in reactions, analysis of, 18: 24618 (NYO-1807-8)
tunneling theory for, 18: 24617 (NYO-1807-7)

NUCLEOTIDES, PYRIDINE TRIPHOSPHATE
reduction and formation of ATP by spinach chloroplasts, 18: 2319 (ANL-6823(p.191-8))

O

OATS
strontium-90 content of, from 1963 harvest, 18: 23804
strontium-90 uptake by, factors affecting, 18: 23206(T) (JPRS-2429 (p.43-7))

OCEANOGRAPHY
dye diffusion studies of currents off Long Island, 18: 25013 (TID-20612)
effects of wind-driven currents on eddy viscosity at various ocean depths and structure of wind waves, 18: 25013 (TID-20612)
of Ligurian Sea, 18: 23167(R) (STI/DOC/10/25(p.71-98))
strontium-90 uptake by marine organisms, 18: 23212
transport of sea-drifters in Solway Firth, tracer study, 18: 23785 (PG-Report-577)

1-OCTENE

radioinduced addition of organic polyhalides to, 18: 23659(T,R) (AEC-tr-6316(p.669-71))
OILS
electron back scattering by saran-film-covered soybean, 18: 23688
OLEIC ACID
radiosensitivity effects of phenoxazine on, 18: 23378
ONIONS
radiation effects on sprouting of bulbs of, 18: 23255
OOGENESIS
radiation effects on, x, 18: 23324
radiosensitivity of various stages in rat, 18: 23340
ORGANIC CHEMISTRY
chromatography in, 18: 25032(T) (SC-T-64-618)
ORGANIC COMPOUNDS
mass spectra of, excess-kinetic-energy ions in, 18: 25019 (UCRL-10823)
radiolysis of, mechanisms of, 18: 24996(R) (NAA-SR-8888(Sect.VI))
sorption by carbonates, hydroxides, organic materials, oxides, phosphates, polyamides, and silicates, 18: 25032(T) (SC-T-64-618)
superconductivity in, theory of, 18: 24554
ORGANIC COOLED REACTORS
coolant decomposition in, 18: 24893(R) (NAA-SR-8888(Sect.III))
coolant purification methods development for, 18: 24893(R) (NAA-SR-8888(Sect.III))
coolant void formation during transient heating in, 18: 24816(R) (NAA-SR-8888(Sect.IV))
ORGANIC MODERATED REACTOR EXPERIMENT
operation during 1963, 18: 24893(R) (NAA-SR-8888(Sect.III))
ORGANIC MODERATED REACTORS
fuel cycle analysis, 18: 24904 (NP-13904)
fuel cycle costs for, analysis of, 18: 24859 (TID-20593)
ORNITHINE
synthesis and transformation in uv photolysis of organic compounds in mixtures with ammonium compounds, 18: 23204(T) (JPRS-24164 (p.19-42))
OSCILLATORS
dynamics of L-R, 18: 24516(T) (JPRS-24633)
spectral line width of, 18: 24516(T) (JPRS-24633)
OSMIUM
content of stony meteorites, 18: 24292
superconductivity, 18: 24179
OSMIUM ALLOYS
superconductivity, 18: 24179
OSMIUM OXIDES
use as fixatives for electron microscopy, 18: 23162(R) (ANL-6823(p.174-7))
OXETANES
3,3-bis(chloromethyl)-, radioinduced solid-state polymerization, 18: 23606(T,R) (AEC-tr-6316(p.208-11))
OXIDASES
activation and inactivation of liver p-hydroxyphenylpyruvic acid, 18: 25009 (TID-19079)
OXIDES
book: *High-Temperature Materials.* No. 1, *Materials Index*, 18: 24075
OXYGEN
additive effects on vacuum-arc melting of refractory alloys and metals, 18: 24070 (RTD-TDR-63-4089)
determination in liquid sodium, development of methods for, 18: 23411(R) (TID-20614)
determination in plutonium oxides and uranium oxides, 18: 23403 (AERE-R-4608)
determination in superheated steam, design of gas chromatograph for, 18: 23407 (DP-880)
effects on corrosion of Zircaloy-2, 18: 24081 (CONF-509-1)
hydrated electron reactions with, rate constants for, 18: 23691
ion reactions at 6.2 and 9.6 Mev, gamma spectra of, 18: 24721
neutron elastic scattering at 3.0 to 4.7 Mev, 18: 24625 (WASH-1046)
neutron reactions at 14 Mev, gamma spectra from, 18: 24604 (NP-13930 (p.54-5))
neutron slowing down in, use of Monte Carlo method for, 18: 24996(R) (NAA-SR-8888(Sect.VI))
protective effects against gamma radiation in *Rhizopus stolonifer*, 18: 23288
radioinduced reactions with Teflon, electron spin resonance studies of, 18: 23648(T,R) (AEC-tr-6316(p.534-7))
radioinduced reactions with acrylamide and methacrylamide monomers and polymers, 18: 23650(T,R) (AEC-tr-6316(p.567-72))
radiosensitivity effects on horse bean plantules, 18: 23299
ratio with uranium in hydrogen sintered uranium dioxide pellets, 18: 24109
reactions with free radicals in irradiated polymers, 18: 23619(T,R) (AEC-tr-6316(p.322-5))
reactions with free radicals formed in irradiation of potassium palmitate, 18: 23670
reactions with molecules in gas systems, de-excitation in, 18: 24315
reactions with radioinduced free radicals in polyethylene, 18: 23620(T,R) (AEC-tr-6316(p.326-42))
reactions with radioinduced free radicals in polypropene, 18: 23622(T,R) (AEC-tr-6316(p.346-52))
temperatures behind reflected shock waves, 18: 24236
thermodynamic properties of plasma of, 18: 24742 (ANL-6802(p.15-18))
OXYGEN IONS
transient rate constants and spectra of, in oxygenated aqueous solutions, pulse radiolysis studies on, 18: 23678
OXYGEN ISOTOPES
separation by exchange between carbon dioxide and ethanolamine solutions, 18: 24052(T) (ORNL-tr-68)
OXYGEN ISOTOPES O-16
alpha scattering at 6 to 19 Mev, analysis of, 18: 24712
deuteron reactions (d,Li-6) at 15 Mev, angular distributions for, 18: 24714
deuteron reactions (d,p) at 11.8 Mev, angular distributions for, 18: 24648
electron inelastic scattering at 40 to 70 Mev, excitation of E1 giant resonance in, 18: 24671
energy levels of, shell-model calculations of odd-parity, 18: 24649
helium ion inelastic scattering at 65 Mev, energy level excitation in, 18: 24623 (UCRL-10727)
helium reactions (He-3,n) at 25 Mev, spectra of, 18: 24650
meson (π^-) reaction, cross sections of particle production in, 18: 24587 (JINR-P-1584)
neutron elastic scattering by, resonances in differentiated, 18: 24620(R) (ORNL-TM-874)
neutron reactions (n,α) with, cross sections for fast, 18: 24643
nitrogen reactions (N-14,O-15) at 27.5 Mev, excitation functions for, 18: 24716
nitrogen reactions (N-14,α) at 27 Mev, angular momentum effects in, 18: 24726
nucleon binding energies in, 18: 24635
reactions (O-16,F-18) at 160 Mev, distorted wave analysis of, 18: 24719
reactions (O-16,N-15) with aluminum-27 at 30 Mev, angular distributions for, 18: 24718
reactions with cadmium, molybdenum, and tin at 36 to 49 Mev, coulomb excitation in, 18: 24620(R) (ORNL-TM-874)
reactions with rare earths, effective charge distribution from, 18: 24624 (UCRL-10806)
reactions with samarium-152 at 18 to 42 Mev, level excitation in, 18: 24727
reactions with thorium-232 and uranium-238, yields from, 18: 24689
reactions with uranium-238 at 90 to 150 Mev, production of spontaneously fissioning isomer in, 18: 24725
scattering by carbon-12, cross sections for elastic, 18: 24674
scattering by carbon-12 at 168 Mev, excitation in, 18: 24709
scattering by lead-208 at 166 Mev, excitation in inelastic, 18: 24708
scattering by rare earth isotopes at 38 to 48 Mev, level excitation in, 18: 24729
scattering by rare earths at 57 Mev, level excitation in, 18: 24730
OXYGEN ISOTOPES O-17
neutron reactions (n,p) with, 18: 24625 (WASH-1046)
OXYGEN ISOTOPES O-18
determination in water by neutron activation, 18: 23426
deuteron reactions (d,Li-6) and (d,Li-7) at 15 Mev, angular distributions for, 18: 24714
energy levels of, even-parity, 18: 24685
exchange between carbon dioxide and water in moisture determination in

cellulose, 18: 23397(T,R) (AEC-tr-6316(p.274-82))
incorporation in water, effects on thermal expansion properties, 18: 23546
neutron reactions (n,y) at 0.2 to 1.0 Mev, cross section for, 18: 24625 (WASH-1046)
neutron reactions (n,d) with, 18: 24625 (WASH-1046)
neutron total cross section of, fast, 18: 24625 (WASH-1046)
radioinduced exchange between carbon dioxide molecules, beta, 18: 23609(T,R) (AEC-tr-6316(p.238-44))
reactions with thorium-232 and uranium-238, yields from, 18: 24689
reactions with thorium-232, yields from, 18: 24690
reactions with thorium-232 at 105 Mev, fission fragment distributions and yields in, 18: 24735

OXYGEN SYSTEMS
Ar–O, oxidation of uranium–zirconium droplets in, 18: 24933 (AFSWC-TDR-63-51)
CeO$_x$–O$_2$, phase studies, 18: 23505
Cl–O–H$_2$O, corrosive effects on 304 and 347 stainless steels, 18: 24125(R) (CEND-3256-209)
D–O, oxygen vibrational de-excitation in, 18: 24315
He–O, oxygen vibrational de-excitation in, 18: 24315
H–O, molecular wave functions of isoelectronic sequence of water, 18: 24296(R) (AD-417517)
H–O, oxygen vibrational de-excitation in, 18: 24315
N–O, corrosive effects on nickel having weldments, 18: 24813(R) (ANL-6880(p.49-67))
N–O, radiation effects on optical spectra of, electron, 18: 24300(R) (NP-13953)
O$_2$–PrO$_x$, phase studies, 18: 23505
O–Si–Ti–W–Zr, development for high-temperature oxidation protection of tungsten, 18: 24086(R) (NP-13898)
O–Si–W, development for high-temperature oxidation protection of tungsten, 18: 24086(R) (NP-13898)
O$_2$–TbO$_x$, phase studies, 18: 23505

OZONE
use for oxidation of cerium for separation from other rare earths, 18: 23727

P

PACIFIC OCEAN
strontium-90 content of water of, in vicinity of Japan, 1959 through 1961, 18: 23792 (WP/37)

PACKAGE POWER REACTORS
conference on, 18: 24895 (NP-13900)
design, 18: 24900 (NP-13900(Sect.6))
design, 18: 24901 (NP-13900(Sect.8))
design for thermoelectric, for underwater applications, 18: 24903 (NP-13900(Sect.10))
design of phosphorus sulfide-cooled thermoelectric, conceptual, 18: 24902 (NP-13900(Sect.9))

PALLADIUM
efficiency drift of foil of, in secondary electron monitor for linear accelerator at 15 Mev, 18: 24253
neutron cross sections and transmission at 1.2 to 10 ev, 18: 24609 (NP-13930(p.112-13))
superconductivity, 18: 24179

PALLADIUM ALLOYS
superconductivity, 18: 24179
Nb–Pd, electric and mechanical properties, 18: 24158

PALLADIUM ISOTOPES Pd-105
neutron capture resonances in, spins of, 18: 24625 (WASH-1046)

PALMITIC ACID
radiation effects on potassium salts of, free radical reactions in, 18: 23670

PANCREAS
radiographic visualization of, as diagnostic method, 18: 23392
radioinduced tumors in rat, x, 18: 23286

PARAFFIN
neutron slowing-down distributions in, 18: 24578

PARAMECIUM
cytological features during mitosis in, 18: 23163(R) (ANL-6823(p.178-88))

PARTICLE STATISTICS
collision probabilities in cuboids and cylinders, 18: 24377 (AEE
collision probabilities in, solution of multigroup equations in, 18: 2437 (AEEW-R-326)

PARTICLE TRACKS
analysis in nuclear emulsion, photometric, 18: 23943
analysis in nuclear emulsion, from elastic single scattering, 18: 23947
analysis in nuclear emulsions, working accuracies for, 18: 23949
analysis of bubble-chamber, computer program for, 18: 23887 (PAN-474/VI)
analysis of emulsion, devices for, 18: 23939
analysis of emulsion, microscopes for, 18: 23940
analysis of emulsion, in magnetic fields, 18: 23946
analysis of nuclear emulsion, semi-automatic devices for, 18: 23941
analysis of nuclear emulsion, devices for, 18: 23942
analysis of spurious, in emulsions, 18: 23936
detection in nuclear emulsion, in relativistic ionization loss region, 18: 23952
determination of spurious, in emulsions, 18: 23934
determination of spurious, in emulsions, 18: 23935
discrimination between, in nuclear emulsion, 18: 23910
discrimination between, in nuclear emulsion, 18: 23911
discrimination between, in emulsion, 18: 23912
discrimination of heavy-ion, in nuclear emulsions, 18: 23954
distortion in emulsions, effects of guard rings on, 18: 23938
distortions and spurious scatterings in emulsion, 18: 23950
distortions and spurious scatterings in, in emulsion, 18: 23951
intensification in nuclear emulsion, for enhanced discrimination, 18: 23931
momentum measurements on multiply scattered high-energy, 18: 23945
production in spark chambers, mechanisms for, 18: 23968
properties of relativistic, in nuclear emulsions, 18: 23953

PARTICLE TRAJECTORIES
analysis of cosmic electron tracks in lead-plate spark chambers, 18: 23973
determination in spark chambers, 18: 23874 (JINR-P-1619)

PARTICLES
characteristics of artificial radioactive, collected by electrostatic precipitator, 18: 23796
quantum statistics of Coulomb-interacting system, 18: 24489
separation from atmosphere by precipitation scavenging, tracer studies using zinc sulfide of, 18: 24212 (HW-SA-3167)
wave equations for, quantization of, 18: 24490

PEAT
sorptive properties for iron, magnesium, and uranium, 18: 23806

PENTAERYTHRITOL
protective effects against radiation damage to plant cells, 18: 23374
radioinduced free radicals in, electron spin resonance studies of, 18: 23649(T,R) (AEC-tr-6316(p.538-50))

2,4-PENTANEDIOL
radioinduced free radicals in, electron spin resonance studies of, 18: 23649(T,R) (AEC-tr-6316(p.538-50))

PENTANES
radiolysis of, hydride ion transfer mechanisms in, 18: 23677

2-PENTANONE, 4-METHYL-
synthesis by radioinduced reactions of acetaldehyde with isobutene, 18: 23610(T,R) (AEC-tr-6316(p.245-52))

PENTYLAMINE
radiosensitivity effects on bean roots, 18: 23379

PEPTIDES
radiation effects on dog, x, 18: 23306
role of, in genic code of DNA, 18: 25011 (TID-20348)

PERCHLORATE IONS
determination in beryllium solutions by cation exchange, 18: 23423

PERCHLORATES
complexes with uranium, stability constants of, 18: 23534

PERSONNEL
neutron dose monitoring for, errors in, in use of nuclear emulsion for, 18: 23961

PERTURBATION THEORY
for neutron transport, 18: 24581

PHASE STUDIES

- equipment and techniques for high-temperature, 18: 24133 (LADC-6391)

PHENANTHRENE, 9,10-DIHYDRO-4,5-DIMETHYL-
- racemization of deuterium-labeled, kinetic isotope effects in, 18: 23574

PHENOXAZINE
- derivatives, protective effects against radiation, 18: 23378

PHENYL SULFIDE
- effects on gamma-induced cis-trans transformation of natural rubber, 18: 23636(T,R) (AEC-tr-6316(p.444-8))

PHONONS
- interactions with electrons in metals and superconductors, 18: 24557
- many-body problem of, in quantum field theory, 18: 24488

PHOSPHATES
- analysis for impurities in phosphorus-32 labeled, activation, 18: 23417
- determination of phosphorus-32 labeled, in labeled pyrophosphates by activation, 18: 23417
- purity of phosphorus-32 labeled, chromatographic and electrophoretic studies on, 18: 23417

PHOSPHORIC ACID, ALKYL ESTERS
- use in paper chromatographic separation of rare earths, 18: 23715

PHOSPHORS
- decay-time constants for, single-photoelectron technique for, 18: 23977
- development of organic liquid, 18: 23975
- efficiency of plastic, for neutrons, 18: 23891 (UCRL-11339)
- excitation energy transfer in liquid, by sampling individual photons, 18: 23978
- temperature effect on plastic, compensation of, 18: 23964

PHOSPHORUS ISOTOPES P-31
- deuteron reactions (d,n) with, angular distributions and cross sections for, 18: 24611 (NP-13930(p.132-3))
- energy levels at 9.42 and 4.43 Mev, 18: 24662
- neutron reactions (n,p) with, for neutron flux measurements, 18: 23885 (NP-13930(p.178-80))
- nitrogen reactions (N-14,N-13) at 27.5 Mev, excitation functions for, 18: 24716

PHOSPHORUS ISOTOPES P-32
- neutron activation of, dose measurement by, 18: 23890 (SCPRI(S)-92)
- preparation by neutron irradiation of phosphorus pentoxide, 18: 24051(T) (JPRS-24590)
- uptake by wheat seed, effects on metabolism in, 18: 23205(T) (JPRS-24290(p.36-42))

PHOSPHORUS OXIDES
- neutron reactions with, phosphorus-32 production in, 18: 24051(T) (JPRS-24590)

PHOTOELECTRIC CELLS
- development, 18: 24356 (ANL-6802(p.64-5))
- development for solar energy conversion, 18: 24353 (ANL-6802(p.24-5))

PHOTOGRAPHIC EMULSIONS
- electron reactions with, latent image formation on, 18: 23907
- neon-20 reactions at 200 Mev, mechanisms of, 18: 24732
- performance for particle detection, comparison with other detectors, 18: 23906
- preparation of, controlled Ostwald maturing in, 18: 23491
- properties of type M NIKFI, 18: 23817
- sensitization by triethanolamine, 18: 23552

PHOTOGRAPHIC FILM
- development of, using dilute amidol baths, 18: 23554
- resolving power of, exposed to spatially varying radiation fields, 18: 23915
- scanning of bubble-chamber, device for ionization measurements in, 18: 24002
- scanning of spark-chamber, flying-spot digitizer on-line with IBM 7090 for automatic, 18: 23998

PHOTOGRAPHIC FILM DETECTORS
- development of, conference, 18: 23904
- performance for low-intensity radiations, 18: 23921
- performance on sounding rockets, 18: 23955
- processing and data recording system for, semi-automatic, 18: 23818 (AWRE-O-93/63)

PHOTOGRAPHY
- developers for, oxidation of dilute amidol, 18: 23554

PHOTOMULTIPLIER TUBES
- applications of fast circuitry in nuclear physics, 18: 24014
- design and performance of high-output wide-linearity, 18: 23980
- development of, for nuclear physics, 18: 24032
- dynode fatigue behavior in, effects of cesium on, 18: 23865
- fabrication of, use of cesium-137 tracer in, 18: 23865
- operation with control electrode as coincidence selector, 18: 24013
- pulse shape of anode current for RCA C 70045 A central-potential, 18: 24033
- pulse spectra and background noise for, 18: 23857
- pulse time and amplitude measuring system for, 18: 23995

PHOTONS
- absorption in solar cells, constants for, 18: 24356 (ANL-6802(p.64-5))
- detection and measurement by inographic emulsion, 18: 23909
- detection and measurement using nuclear emulsion, 18: 23914
- emission in electron reactions with neon at 25 to 150 ev, time correlation of, 18: 24700
- emission in meson (π^-) reactions with carbon and nitrogen at 7.5 Bev, 18: 24390 (JINR-P-1624)
- energy spectra from meson (π^-) interactions with carbon, nitrogen, and nucleons, 18: 24391 (JINR-P-1629)
- interactions with deuterons at 11 to 130 Mev, cross sections and polarizations for disintegration in, 18: 24416
- interactions with protons, mesons (η) production in, 18: 24438
- interactions with neutrinos in universe, theory for, 18: 24348
- interactions with protons, single meson (π) production in, 18: 24380 (DESY-64/3)
- production in meson (π)-proton interactions at 9 Bev, forward, 18: 24417
- reactions with interstellar magnetic fields, Doppler shift from, 18: 24289
- relative biological effectiveness of high-energy, 18: 23314

PHTHALATES
- radiolysis of aqueous solutions of, uv spectra of transients in, 18: 23683

PHYSICS
- dimensions and units in, formalism for, 18: 24221
- research progress in, in Communist China, selected translations on, 18: 25025(T) (JPRS-24552)
- research progress in Communist China, selected translations on, 18: 25026(T) (JPRS-24593)

PIGMENTS
- role of manganese in melanin formation and function in man, 18: 23199 (BNL-828)

PINCH DEVICES
- development, 18: 24763(R) (UCRL-11172)

PINCH EFFECT
- plasma spectral line profiles in Z, interferometric measurements of, 18: 24791
- stability of tubular-sheet, finite-resistivity, 18: 24762 (UCRL-7077)

PIPES
- fluid flow measurements by isotopic dilution in, use of pump to reduce mixing length for, 18: 23762 (AERE-R-4623)
- heat transfer in steam–water and water flows through, 18: 24910(R) (SRO-101)
- perturbation propagation in liquids in pump aggregate, calculations for harmonic, 18: 25024(T) (ANL-Trans-24)
- welding for pressure systems, Hanford guide of procedures and specifications for, 18: 24102 (TID-20625(Vol.I))

PIPETTES
- design of remotely controlled, for use in hot cells, 18: 23842 (UCRL-9661)

PITUITARY GLAND
- radiation effects on oxytocin content of rat, x, 18: 23275
- radioinduced tumors in rat, astatine-211, 18: 23261

PLANETS
- Mercury, relativistic contributions to perihelion rotation of, 18: 24287
- radio emission from venus, ionospheric model for, 18: 24516(T) (JPRS-24633)

PLANKTON
- strontium-90 content of, from Pacific Ocean in vicinity of Japan, 1959 through 1961, 18: 23792 (WP/37)

PLANT CELLS
- radiation effects on cotton, gamma, 18: 23300
- radiation effects on, evaluation of various compounds for protection against, 18: 23374
- radiation injuries of, mechanisms for, 18: 23316

PLANT METABOLISM
- effects of phosphorus-32 on wheat seed, 18: 23205(T) (JPRS-24290 (p.36-42))
- role of oxidation ferments in, 18: 25023(T) (ANL-Trans-21)

PLANTS
- chemical composition of marine, 18: 23167(R) (STI/DOC/10/25(p.71-98))
- growth and development of, after exposure of seeds to low-dose x radiation or soaking in distilled water, 18: 23253(T) (OTS-61-11326)
- growth in irradiated soil, 18: 23318
- radiation effects on parasites of grain, gamma, 18: 23270
- radioactive contamination of vegetables from fallout in Osaka Prefecture, Oct. 1961 to Dec. 1963, 18: 23797
- radioactivity content in aquatic, methods for expression of, 18: 23172
- radioinduced mutations in *Phaseolus mungo*, 18: 23263
- radiosensitivity of horse bean, effects of oxygen pressure on, 18: 23299
- soil relations to, in arid regions, 18: 23168(R) (STI/DOC/10/25(p.99-111))
- tritium labeling of ketones in Artemisia, 18: 23564

PLASMA
- acceleration of bundles of highly ionized, in linear accelerator, 18: 24775
- acceleration of, diffusion and friction in, 18: 24795
- analysis of, geometric optics, 18: 24799
- bremsstrahlung emission from fully ionized, r-f, 18: 24792
- charged particle reactions with nonequilibrium, energy losses in, 18: 24802
- confinement and density in, 18: 24779
- containment of, bibliography on, 18: 24748 (CLM-Bib-4)
- containment of, equipment for, 18: 24804(P)
- containment of, research progress on magnetic, 18: 24740(R) (AD-426769)
- density, electron temperature, and plasmoid velocity in coaxial injector, probe measurements of, 18: 24782
- diagnostics of, behavior of resonance probe below plasma frequency for, 18: 24771
- diagnostics of, lasers for, 18: 24783
- diagnostics using electromagnetic waves, 18: 24744 (ANL-6802 (p.113-19))
- diagnostics using lasers, 18: 24745 (ANL-6802(p.120-5))
- diagnostics using negatively biased Langmuir ion collection probe with guard ring, 18: 24756 (NP-13946)
- diffusion of ionospheric, ambipolar, 18: 24781
- dynamics of, review on, 18: 24764 (UTIAS-Rev-18)
- electric conductivity of Lorentz, in time-dependent electric field, 18: 24761 (NP-13952)
- electric conductivity of Lorentz gases, 18: 24785
- electric discharge in, stability of, 18: 24784
- electromagnetic wave scattered by moving body in, frequency of, 18: 24741 (AFOSR-5367)
- electromagnetic wave transformation on boundary of, in magnetic field, 18: 24766(T) (JPRS-24633(p.62-77))
- electromagnetic waves in drifting, group velocity of, 18: 24777
- electromagnetic waves in multicomponent, low-frequency, 18: 24778
- electron interactions with bunches of, in synchrotrons, 18: 24265
- electron reactions with ions in, energy balance and recombination in, 18: 24793
- electron reactions with ions in, energy balance and recombination in, 18: 24794
- electron recombination coefficient in dense low-temperature, 18: 24801
- electron-ion interactions in, damping of two-stream instabilities by, 18: 24759 (NP-13950)
- flow in cylinders, analysis of, 18: 24769
- heating of, equipment for, 18: 24804(P)
- interactions with fields, review on, 18: 24746 (ARL-64-34)
- interactions with radiation fields, kinetic equations for, 18: 24789
- ion motion in liquid-helium, 18: 24739(R) (AD-417496)
- ion relaxation in, theory for fast, 18: 24760 (NP-13951)
- ionization and recombination in steady-state, 18: 24751 (EUR-CEA-FC-200)
- kinetic equations for electrons and photons in, in magnetic field, 18: 24765(T) (JPRS-24633(p.43-61))
- light scattering by, 18: 24788
- magnetic skin effect in, 18: 24800
- measurement in space, 18: 24749 (CONF-521-2)
- mechanism of high-frequency plasmoid, 18: 24774
- microwave emission from column of, resonances in, 18: 24786
- oscillations in magnetized, stability of longitudinal, 18: 24787
- particle distribution in electron, Fokker-Planck coefficients for, 18: 24753 (N64-13056)
- particle free path length in, calculations of, 18: 24773
- pinch discharge in, spectral line profiles in Z, 18: 24791
- production and properties, 18: 24763(R) (UCRL-11172)
- production in electron-beam melting of metals, 18: 24798
- production of highly excited neutral atoms for injection, 18: 24757 (NP-13948)
- production of highly excited neutral atoms for injection, 18: 24758 (NP-13949)
- production of lithium, 18: 24750 (EUR-1627.f)
- production of supersonic high electron density, 18: 24743 (ANL-6802 (p.29-36))
- productions of high-temperature, particle injection into mirror machines for, 18: 24767(T) (KFK-tr-141)
- properties of, anonymous description and hydrodynamical approximation, 18: 24770
- radiation scattering by, spectral density of, 18: 24752 (MATT-217)
- stability in long tubes, 18: 24797
- stability in streams of, wave amplification from cyclotron, 18: 24790
- stability in triaxial pinch, finite-resistivity, 18: 24762 (UCRL-7077)
- stability of ionospheric, 18: 24780
- stability of potassium, in magnetic fields of 600 to 1600 oersted, 18: 24803
- stability of, collision damping of two-stream instabilities, 18: 24759 (NP-13950)
- thermodynamic properties, 18: 24742 (ANL-6802(p.15-18))

PLASMA JETS
- design parameters for constant-velocity traveling magnetic wave, 18: 24754 (NASA-TN-D-2278)
- thermal ionization in, with electronegative species, 18: 23532

PLASTICS
- testing of lining materials of, by diffusion of aggressive liquids, 18: 25022(T) (ANL-Trans-15)
- use in neutron shielding, 18: 24809(P)

PLATINUM
- coating with radioactive rare earth for use as radiation source, 18: 24
- electron bombardment of films of, products from, 18: 24319
- performance as electrodes in ion engines in spacecraft, 18: 23740(R) (NP-13899)
- separation from gold by cation exchange, 18: 23718
- sorption of americium-241 and protactinium-233 by, from water–ethanol solutions, 18: 23724
- superconductivity, 18: 24179
- wetting by molten chlorides and fluorides, sessile drop observations, 18: 23437 (CONF-322-12)

PLATINUM ALLOYS
- superconductivity, 18: 24179
- Ir–Pt, performance as electrodes in ion engines in spacecraft, 18: 23740(R) (NP-13899)

PLATINUM COMPOUNDS
- use as fixatives for electron microscopy, 18: 23162(R) (ANL-6823 (p.174-7))

PLOWSHARE PROJECT
- effect of large underground Sedan explosion on lizard population of Neva Proving Grounds, 18: 23181 (UCLA-12-522)

PLUTONIUM
- body burden assessment of, in man, 18: 23825 (LADC-6104)
- determination in dry waste containers, apparatus for, 18: 23828(R) (UCRL-7637)
- effects on mice of injecting, protective effects of diethylenetriaminepentaacetic acid against, 18: 23351(R) (ANL-6823(p.114-15))
- fabrication of fuel elements of, radiological control of, 18: 23824 (HW-81363)
- handling methods for, 18: 24865(T,R) (EURAEC-992)
- neutron resonance integrals of, concentration and temperature effects on, 18: 24861 (WCAP-6060)

separation from americium by ion exchange, capabilities at Rocky Flats for, 18: 23706 (RFP-349)
separation from breeder elements, process for, 18: 24929(P)
separation from fuels, by fluoride volatility method, 18: 24813(R) (ANL-6880(p.49-67))
separation from irradiated fuels by solvent extraction, solvent purification process for, 18: 23698 (CEA-R-2404)
separation from irradiated aluminum–plutonium alloys by ion exchange, 18: 23702 (ORNL-3566)
separation from irradiated uranium dioxide fuels by chloride volatility methods, 18: 23704 (ORNL-TM-828)
separation from praseodymium, solvent-extraction, 18: 24952(R) (ANL-6880(p.6-48))
tumorigenic effects in rats, 18: 23232(R) (ANL-6823(p.81-5))
ultrafiltration method for determining colloidal state of, 18: 23190(R) (ANL-6823(p.111-13))
uptake by mouse bone and liver, effects of diethylenetriaminepentaacetic acid on, 18: 23350(R) (ANL-6823(p.105-8))
uptake by tibia from bone marrow, 18: 23189(R) (ANL-6823(p.109-10))
uses as reactor fuel, economic aspects of, 18: 24858(R) (HW-80560F)
welding of clad, 18: 24100 (HW-SA-3146)

PLUTONIUM ALLOYS
welding of clad, 18: 24100 (HW-SA-3146)
Al–Pu, separation of plutonium and transuranium elements from irradiated, by ion exchange, 18: 23702 (ORNL-3566)
Al–Pu–U, performance as zero-power reactor fuel, 18: 24952(R) (ANL-6880(p.6-48))
Ce–Co–Pu, thermodynamic properties of liquid and solid, 18: 24815(R) (MLM-1184)
Ce–Cu–Pu, phase studies, 18: 24815(R) (MLM-1184)
Ce–Ni–Pu, phase studies, 18: 24815(R) (MLM-1184)
Ce–Pu, phase studies, 18: 24815(R) (MLM-1184)
Cu–Pu–U, performance as zero-power reactor fuel, 18: 24952(R) (ANL-6880(p.6-48))
Fe–Pu, viscosities of, 18: 24815(R) (MLM-1184)
Fe–Pu–U, performance as zero-power reactor fuel, 18: 24952(R) (ANL-6880(p.6-48))
fissium–Pu–U, development for fast reactor fuels, 18: 24952(R) (ANL-6880(p.6-48))
fissium–Pu–U, performance as zero-power reactor fuel, 18: 24952(R) (ANL-6880(p.6-48))
Mo–Pu–U, performance as zero-power reactor fuel, 18: 24952(R) (ANL-6880(p.6-48))
Pu–U, development for fast reactor fuels, 18: 24952(R) (ANL-6880 (p.6-48))
Pu–U, performance as zero-power reactor fuel, 18: 24952(R) (ANL-6880(p.6-48))
Pu–U, reactivity in critical assemblies, 18: 24865(T,R) (EURAEC-992)
Pu–U–Zr, performance as zero-power reactor fuel, 18: 24952(R) (ANL-6880(p.6-48))
Pu–Y, phase studies, 18: 24815(R) (MLM-1184)

PLUTONIUM CARBIDES
radiation effects on, 18: 24813(R) (ANL-6880(p.49-67))
PuC–UC, burnup testing, 18: 24988(R) (BMI-1665(Del.))

PLUTONIUM COMPOUNDS
preparation of perovskite-type, 18: 23521(P)

PLUTONIUM ISOTOPES Pu-239
alpha reactions at 30 to 45 Mev, production of spontaneously fissioning isomer in, 18: 24725
distribution and retention in rat adrenals, 18: 23221
fission rate in graphite-moderated assembly, 18: 24852
helium ion reactions (He-3, He-4) at 25 Mev, 18: 24625 (WASH-1046)
neutron capture-to-fission ratio of, measurement of, 18: 24625 (WASH-1046)
neutron fission of, energy dependence of number of neutrons from, 18: 24640
proton fission of, 18: 24625 (WASH-1046)
removal from mouse tissues using calcium salt or pentaethyl ester of carboxymethyliminobis(ethylenenitrilo)tetraacetic acid, 18: 23369

PLUTONIUM ISOTOPES Pu-240
alpha reactions at 30 to 45 Mev, production of spontaneously fissioning isomer in, 18: 24725

PLUTONIUM ISOTOPES Pu-241
neutron fission cross sections at 2 to 100 ev, 18: 24586 (IDO-16976)
neutron fission cross section and resonance parameters of, 18: 24625 (WASH-1046)

PLUTONIUM ISOTOPES Pu-242
alpha reactions at 30 to 45 Mev, production of spontaneously fissioning isomer in, 18: 24725

PLUTONIUM NITRIDES
compatibility with sodium at 950°C, 18: 24988(R) (BMI-1665(Del.))
decomposition pressure at 2290 to 2770°, variation with temperature, 18: 23482
preparation and properties, 18: 24988(R) (BMI-1665(Del.))

PLUTONIUM OXIDES
analysis for oxygen/metal ratios, 18: 23403 (AERE-R-4608)

PLUTONIUM(IV) OXIDES
deposition on aluminum, electrolytic, 18: 23537
preparation and properties of, 18: 24815(R) (MLM-1184)
PuO_2–SiO_2, preparation and properties of pellets of, 18: 24815(R) (MLM-1184)
PuO_2–ThO_2, preparation and properties of pellets of, 18: 24815(R) (MLM-1184)
PuO_2–UO_2, preparation for reactor fuel, 18: 24868(P)
PuO_2–ZrO_2, preparation and properties of pellets of, 18: 24815(R) (MLM-1184)

PLUTONIUM PHOSPHIDES
crystal structure, 18: 24988(R) (BMI-1665(Del.))

PLUTONIUM POISONING
pathology of, in man, 18: 23825 (LADC-6104)

PLUTONIUM RECYCLE TEST REACTOR
control systems for, annunciator for, 18: 24887 (HW-80921)

PLUTONIUM SYSTEMS
C–Pu–U, performance as zero-power reactor fuel, 18: 24952(R) (ANL-6880(p.6-48))

PLUTONYL CARBONATES
complexes of, preparation and structure of, 18: 23538

POLONIUM ALLOYS
Po–rare earths, preparation and properties, 18: 24127 (CONF-405-33)

POLONIUM ISOTOPES Po-210
effects on DNA metabolism in rats, 18: 23382

POLYMERS
chain interactions in macromolecular, volume effect in, 18: 25034(T) (SC-T-64-902)
coating of surfaces with radiocured, method for, 18: 23400(P)
radioinduced free radicals in, kinetics of formation of, 18: 23654(T,R) (AEC-tr-6316(p.609-15))
radioinduced oxidation of, electron spin resonance studies of, 18: 23619(T,R) (AEC-tr-6316(p.322-5))
testing of plastic lining materials by diffusion of aggressive liquids, 18: 25022(T) (ANL-Trans-15)

POLYPHENYLS
decomposition of reactor coolant, 18: 24893(R) (NAA-SR-8888 (Sect.III))

POLYSACCHARIDES
degradation from cartilage of protein-, 18: 23217

POPULATIONS
growth predictions for, mathematical model for, 18: 25012 (TID-20579)

PORTUGAL
nuclear power prospects in, 18: 24922

POSITRONS
interactions with electrons, W-boson production in, 18: 24397 (NP-13954)
polarization of fast, by bremsstrahlung, 18: 24435

POTASSIUM
corrosive effects on niobium-base alloys at 2000 to 2200°F, 18: 24091
electron elastic scattering cross sections at low energies, 18: 24298 (N64-13373)
neutron total cross sections at 8.58 to 11.59 Mev, 18: 24591(R) (LMSC-4-50-62-1)
performance in thermionic cells, 18: 24362 (ANL-6802(p.152-60))
sorption by phosphoric acid resins, effects of acidity on selectivity coefficients for, 18: 23481

POTASSIUM ACID CARBONATES

isotope exchange with carbon dioxide, effects of solution flow rate on, 18: 24053(T) (ORNL-tr-69)

POTASSIUM ALLOYS

Hg–K, performance in fuel cells, 18: 24354 (ANL-6802(p.49-52))

POTASSIUM CHLORATES

reactions with tetravalent uranium ions in perchloric acid, 18: 23541

POTASSIUM CHLORIDES

density of liquid, 18: 24813(R) (ANL-6880(p.49-67))

KCl–NaCl, corrosive effects on metals at 700, 800, and 900°C, 18: 24089

LiCl–MgCl$_2$–KCl, phase studies on, 18: 24813(R) (ANL-6880(p.49-67))

MgCl$_2$–KCl–NaCl, solvent properties for praseodymium, 18: 24952(R) (ANL-6880(p.6-48))

POTASSIUM COMPOUNDS

radiation effects on palmitate, free radical reactions in, 18: 23670

POTASSIUM CYANIDES

nitrogen-15 NMR in, chemical shifts in, 18: 23530

POTASSIUM FERROCYANIDES

uses in electrophoretic separation of alkali metals, 18: 23730

POTASSIUM HALIDES

proton relaxation times in aqueous solutions of, 18: 23559

POTASSIUM IODATES

radiolysis in basic aqueous solutions, yields from gamma, 18: 23674

POTASSIUM IONS

mobility in aqueous solutions of potassium nitrate at 25°C, 18: 23467

sputtering of tungsten at 750 to 2500 ev by, tracer studies of cathodic, 18: 24776

POTASSIUM ISOTOPES K-38

gamma spectra, 18: 24585(R) (IDO-16969)

POTASSIUM ISOTOPES K-39

mobility of ionic, in aqueous solutions of potassium nitrate at 25°C, 18: 23467

neutron reactions (n,2n) at 12.5 to 19.6 Mev, cross sections for, 18: 24602 (NP-13930(p.43-9))

nitrogen reactions (N-14,O-15) at 27.5 Mev, excitation functions for, 18: 24716

POTASSIUM ISOTOPES K-40

content in Swedish food, 1962, 18: 23790 (NP-13828)

energy levels of, shell model calculations of, 18: 24634

POTASSIUM ISOTOPES K-41

mobility of ionic, in aqueous solutions of potassium nitrate at 25°C, 18: 23467

POTASSIUM ISOTOPES K-42

mobility of ionic, in aqueous solutions of potassium nitrate at 25°C, 18: 23467

POTASSIUM MOLYBDATES

MoO$_3$–K$_2$MoO$_4$, temperature effects on density and electric conductivity of, 18: 23486

POTASSIUM NITRATES

effects on yields of hydrogen in hydrolysis of water, mechanism of, 18: 23681

potassium ion mobility in aqueous solutions of, at 25°C, 18: 23467

POTASSIUM PHOSPHATES

effects on strontium-90 uptake by oats, 18: 23206(T) (JPRS-24290 (p.43-7))

POTASSIUM SULFATES

reactions with cerium, 18: 23539

POTASSIUM SYSTEMS

Ar–K, production of supersonic plasma of, 18: 24743 (ANL-6802(p.29-36))

He–K, production of supersonic plasma of, 18: 24743 (ANL-6802 (p.29-36))

POTASSIUM URANYL PHOSPHATES

solubility of, tracer studies of, 18: 23545

POWDER METALLURGY

conference on application of high pressure in metal-deformation processing, Bureau of Naval Weapons, BMI, Columbus, Ohio, Oct. 3, 1963, 18: 24099 (DMIC-199)

POWER BREEDER REACTORS

criticality studies in ZPR-III, ELMOE code for, 18: 24813(R) (ANL-6880(p.49-67))

criticality studies on Rapsodie in ZPR-III, 18: 24952(R) (ANL-6880(p.6-48))

POWER CYCLES

development of Stirling, for MHD cells, 18: 24364 (ANL-6802(p.166-

POWER REACTORS

book: *Structures for Nuclear Power*, 18: 24926

control of, shaped charges containing poison for, 18: 24876 (APEX-14

coolant systems for, design of steam, 18: 24930(P)

data processing for French, using numerical units, 18: 24828

design of heavy water-moderated steam-cooled, 18: 24928(P)

development of, role of MTR in, 18: 24973

feasibility study of dual-purpose, for Florida Keys, 18: 24906 (NYO-10719)

fuel cost analysis for heavy-water natural-uranium, 18: 24905 (NP-13905)

fuel cycle analysis of organic moderated, 18: 24904 (NP-13904)

hazards evaluation in STEP project, 18: 24956(R) (IDO-16961)

neutron moderation in, graphite-water ratio effects on, 18: 24888 (HW-SA-3507)

POWER SUPPLIES

development of fission-electric, 18: 24372(R) (TID-20575)

development of nuclear-thermionic, summary, 18: 24857(R) (GEST-2031)

development of thermoelectric, for space uses, 18: 24351(R) (AD-427285)

development of thermionic, summary, 18: 24369(R) (NP-13892)

development of thermionic, for space uses, 18: 24370(R) (PWA-2337)

development of thermionic, summary, 18: 24350(R) (AD-418276)

performance of explosive-MHD-cell, 18: 24365(R) (ASD-TDR-63-37)

power conditioning, distribution, and generation systems in, 18: 249

PRASEODYMIUM

antiferromagnetism of, 18: 24172

density of liquid, at 937 to 1190°C, 18: 24815(R) (MLM-1184)

heat of solution in liquid tin at 750°K, 18: 24183

magnetic properties of, effects of crystalline field and structure on, 18: 24186

polarographic behavior in tetraethylammonium bromide at dropping mercury electrode, 18: 23463

separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)

separation from plutonium-bearing fuels, solvent-extraction, 18: 24952(R) (ANL-6880(p.6-48))

PRASEODYMIUM ALLOYS

Bi–Pr, vaporization at 1350 to 1610°K, 18: 23510

Fe_2Pr, neutron diffraction study of magnetic behavior and structure, 18: 24184

PRASEODYMIUM BISMUTHIDES

thermodynamic properties at 1350 to 1610°K, 18: 23510

PRASEODYMIUM CHLORIDES

solubility of gypsum in aqueous solutions of, 18: 23536

PRASEODYMIUM COMPLEXES

with 2,2′-dipyridyl, preparation and fluorescence and infrared spectra of, 18: 23500

PRASEODYMIUM COMPOUNDS

spectra of, evidence of covalent binding in, 18: 23438 (CONF-405-35)

PRASEODYMIUM IONS

covalency of, spectral evidence of, 18: 23438 (CONF-405-35)

PRASEODYMIUM ISOTOPES Pr-139

gamma spectra, 18: 24585(R) (IDO-16969)

PRASEODYMIUM ISOTOPES Pr-141

neutron resonances below 2 kev, 18: 24620(R) (ORNL-TM-874)

PRASEODYMIUM ISOTOPES Pr-142

production in neon-22 and oxygen-18 reactions with thorium-232, 18: 24690

PRASEODYMIUM ISOTOPES Pr-143

production in neon-22 and oxygen-18 reactions with thorium-232, 18: 24690

PRASEODYMIUM ISOTOPES Pr-144

separation by calcium phosphate–humic acid flocculation, 18: 2498

PRASEODYMIUM ISOTOPES Pr-145

production in neon-22 and oxygen-18 reactions with thorium-232, 18: 24690

PRASEODYMIUM OXALATES

dynamic decomposition of, effects of air, carbon dioxide, and nitrogen on, 18: 23507
PRASEODYMIUM OXIDES
phase transitions in, 18: 23504
preparation by acetic acid leaching, nature of chemisorbed acetate in, 18: 23514
spectra in low frequency region, infrared, 18: 23549
O_2-PrO_x, phase studies, 18: 23505
PRASEODYMIUM SULFATES
dissociation in water, constants and spectra of, 18: 23501
PREGNANCY
radiation hazards from diagnostic radiographic examinations during, 18: 23831
PRESSURE
effects on superconducting properties, 18: 24560
PRESSURE GAGES
design of radiometric, 18: 24048(P)
PRESSURE REGULATORS
design of liquid, with rapid response, 18: 23867(P)
PRESSURE VESSELS
design, 18: 24897 (NP-13900(Sect.2))
design of cooling system for concrete, for reactors, 18: 24830(P)
design of prestressed concrete, 18: 24825
development for Maritime Nuclear Steam Generator, 18: 24939(R) (GEMP-285)
fatigue life of, method of predicting, 18: 24130 (D2-22437)
radiation effects on reactor, measurement of, 18: 23780(R) (SWRI-1243-11)
stress analysis of thin-shell, for reactors, 18: 24824(R) (TID-20613)
welding of, Hanford guide of procedures and specifications for, 18: 24102 (TID-20625(Vol.I))
PRESSURIZED WATER REACTORS
coolant circulating system for, design of, 18: 24831(P)
design of portable, 18: 24901 (NP-13900(Sect.8))
feasibility study of dual-purpose, for Florida Keys, 18: 24906 (NYO-10719)
hazards evaluation in STEP project, 18: 24956(R) (IDO-16961)
neutron moderation in, graphite-water ratio effects on, 18: 24888 (HW-SA-3507)
operations of VVR-M, 18: 24958 (NP-13907)
PROCAINE
radiosensitivity effects, 18: 23384
PRODUCTION REACTORS
economics of, summary, 18: 24858(R) (HW-80560F)
PROLINE
photolysis of, transformation of amino acids in uv, 18: 23204(T) (JPRS-24164(p.19-42))
synthesis and transformation in uv photolysis of organic compounds in mixtures with ammonium compounds, 18: 23204(T) (JPRS-24164 (p.19-42))
PROMETHIUM
magnetic properties of, effects of crystalline field and structure on, 18: 24186
PROMETHIUM ISOTOPES Pm-147
metabolism in miniature swine, 18: 23200 (HW-SA-3350)
PROMETHIUM ISOTOPES Pm-149
production in neon-22 and oxygen-18 reactions with thorium-232, 18: 24690
PROMETHIUM ISOTOPES Pm-150
production in neon-22 and oxygen-18 reactions with thorium-232, 18: 24690
PROMETHIUM ISOTOPES Pm-151
production in neon-22 and oxygen-18 reactions with thorium-232, 18: 24690
PROPANE
meson (π^-) absorption in, 18: 24475
PROPANE, 1-IODO-
electric conductivity of aluminum, gallium, and indium iodides in, 18: 23449 (PAN-491/V)
1,3-PROPANEDIONE, 1,3-DIPHENYL-
with europium, laser action in, 18: 24229
1-PROPANESULFONIC ACID, 2,3-DIMERCAPTO-
effects on deoxycytidine urinary excretion in radiation sickness, 18: 23382
2-PROPANOL
radioinduced reactions with ethylene, gamma, 18: 23612(T,R) (AEC-tr-6316(p.261-5))
radiolysis of aqueous solutions of, uv spectra of transients in, 18: 23683
2-PROPANONE, 1-BROMO-
radioinduced polymerization of, gamma, 18: 23601(T,R) (AEC-tr-6316 (p.178-81))
2-PROPANONE, 1-CHLORO
radioinduced polymerization of, gamma, 18: 23601(T,R) (AEC-tr-6316 (p.178-81))
PROPENE
radioinduced additions of hydrogen sulfide to, yields in, 18: 23668
radioinduced graft polymerization of sulfur dioxide and, on polyethylene, gamma, 18: 23642(T,R) (AEC-tr-6316(p.481-97))
radioinduced polymerization with tetrafluoroethylene at low temperature, mechanism of, 18: 23684
PROPENE, 2-METHYL-
radioinduced additions of hydrogen sulfide to, yields in, 18: 23668
radioinduced polymerization with tetrafluoroethylene, infrared spectra, melting points, and x-ray diffraction of products from, 18: 23685
radioinduced reactions with acetaldehyde, gamma, 18: 23610(T,R) (AEC-tr-6316(p.245-52))
PROPENE, 2-METHYL- POLYMERS
radioinduced branching in, effects of temperature on, 18: 23682
radiolysis of, double bond formation and gas evolution in, 18: 23669
PROPENE POLYMERS
radiation effects on EPR spectra of stretched, 18: 23679
radioinduced free radicals in, effects of pretreatments on, 18: 23615(T,R) (AEC-tr-6316(p.295-305))
radioinduced free radicals in, singlets in electron spin resonance spectra produced at high doses, 18: 23616(T,R) (AEC-tr-6316(p.306-9))
radioinduced free radicals in, output saturation in electron spin resonance spectra of, 18: 23617(T,R) (AEC-tr-6316(p.310-13))
radioinduced free radicals in, concentration of, 18: 23618(T,R) (AEC-tr-6316(p.314-21))
radioinduced free radicals in, oxidation of, 18: 23619(T,R) (AEC-tr-6316 (p.322-5))
radioinduced free radicals in, oxidation of, 18: 23622(T,R) (AEC-tr-6316 (p.346-52))
radioinduced free radicals in, effects on graft reactions, 18: 23624(T,R) (AEC-tr-6316(p.368-80))
radioinduced graft polymerization of styrene on, gamma, 18: 23589(T,R) (AEC-tr-6316(p.105-13))
PROPIONALDEHYDE
radioinduced polymerization on alumina base, gamma, 18: 23594(T,R) (AEC-tr-6316(p.137-44))
PROPIONIC ACID
photolysis in mixture with ammonium nitrate, formation of amino acids in uv, 18: 23204(T) (JPRS-24164(p.19-42))
PROPIONITRILES
radioinduced polymerization, 18: 23596(T,R) (AEC-tr-6316(p.152-3))
radioinduced polymerization of, solvent effects of ethylene on, 18: 23627(T,R) (AEC-tr-6316(p.432-4))
PROPIOPHENONE, p-AMINO-
protective effects of, against radiation injuries in rats, synergistic effects of 2-imino-thiazolidine-4-carboxylic acid, 18: 23353(R) (NP-13918(p.42-57))
protective effects of, against radiation injuries in mice, 18: 23357(R) (NP-13918(p.107-15))
toxic effects of, in diet of normal and irradiated mice, 18: 23358(R) (NP-13918(p.116-28))
PROPORTIONAL DETECTORS
design of portable, for neutron counting for determining weights of deposits of uranium fluorides in process equipment, 18: 23875 (K-1586)
efficiency of boron trifluoride, for fast neutrons, 18: 23900
use for discrimination of low-energy photons and high-energy electrons, 18: 23974
window amplifier for, for pulse spectral analysis, 18: 23839 (PAN-479/I)

PROPULSION
electric, energy conversion problems in, 18: 24358 (ANL-6802(p.89-99))
electric, performance of perforated ion emitters for, 18: 24366 (ASD-TDR-63-750)
ion, development of systems for, 18: 23740(R) (NP-13899)
ion, propellant feed systems for, 18: 23754 (NASA-CR-51)
plasma jet, engine design for, 18: 24754 (NASA-TN-D-2278)
PROPYLAMINE
dissociation by electron bombardment, mass spectra from, 18: 23608(T,R) (AEC-tr-6316(p.232-7))
PROPYNE, 3-BROMO-
radioinduced polymerization, 18: 23596(T,R) (AEC-tr-6316(p.152-3))
2-PROPYN-1-OL-
radioinduced polymerization, 18: 23596(T,R) (AEC-tr-6316(p.152-3))
PROTACTINIUM
separation from neptunium by ion exchange, 18: 23409 (RT/CHI(63)-31))
separation from niobium and zirconium by solvent extraction using benzoylphenylhydroxylamine, 18: 23728
solvent extraction from nitric acid by TBP in presence of various cations, 18: 23720
PROTACTINIUM ISOTOPES Pa-231
effects on catalytic activity of magnesium sulfate in dehydration of cyclohexanol, 18: 23672
PROTACTINIUM ISOTOPES Pa-233
neutron total cross section of, 18: 24625 (WASH-1046)
preparation of samples of, 18: 24625 (WASH-1046)
sorption from water–ethanol solutions, 18: 23724
PROTECTIVE CLOTHING
development and testing, 18: 23828(R) (UCRL-7637)
PROTEINS
deuterium-hydrogen exchange of fibroin between heavy and light water and silk, 18: 23470
effect of infection on blood serum content of, in irradiated rabbits, 18: 23174
radiation effects on amino acid incorporation by, x, 18: 23259
radiation effects on electron spin resonance patterns of, gamma, 18: 23289
radiation effects on metabolism in adrenal glands of guinea pigs, 18: 23321
rat liver soluble nuclear, factors affecting, 18: 23192(R) (ANL-6823 (p.124-7))
PROTON BEAMS
chemical effects on water at 1 to 2 Mev, 18: 23578 (LFEN-15)
PROTON SCATTERING CROSS SECTIONS
for heavy nuclei, effects of nuclear deformation on, 18: 24665
PROTON SHIELDING
design for space vehicles, optimization theory for, 18: 24805 (UNC-5049)
design for space vehicles, electrostatic, 18: 24807
PROTONS
absorption and transmission by nuclei, optical model calculations of, 18: 24595 (NP-13930(p.6-13))
acceleration in CERN linear accelerator, 18: 24241 (CERN-64-22)
angular and energy distributions from gamma reactions (γ,p) with lithium-6 at 5.7 to 20 Mev, 18: 24695
biological effects of, in mice, 18: 23357(R) (NP-13918(p.107-15))
detection and discrimination in nuclear emulsion, 18: 23929
detection and discrimination from alpha particles in emulsion, 18: 23931
detection and discrimination of low-lying emulsions, 18: 23932
detection and discrimination in nuclear emulsions, 18: 23933
detection and discrimination of low-energy, in emulsions, 18: 23943
detection and measurement of 22-Bev, using nuclear emulsion, 18: 23911
detection and measurement in emulsions, at 7 to 24 Bev, 18: 23934
detection and measurement in nuclear emulsions, at 24 Bev, 18: 23935
detection and measurement using semiconductor counter telescope, 18: 23985
detection of 19.6-Bev/c, in nuclear emulsions, 18: 23953
effects of 126-Mev, on corneal epithelium in mice, 18: 23303
emission in deuteron reactions (d,p) with nuclei at 11.8 Mev, angular distributions for, 18: 24648
emission in lighium-6 reactions with light nuclei at 36 and 63 Mev, spectra of, 18: 24723
emission in lithium reactions with boron-10 and -11 at 3.5 to 4.5 Mev, angular distributions for, 18: 24720
emission of delayed, possibility of, 18: 24736
energy distributions from fast neutron reactions with polyethylene films, neutron spectra determinations from, 18: 23883 (NP-13930(p.147-57))
interactions at high energies, fundamental lengths in, 18: 24436
interactions at 650 Mev, meson (π) production in, 18: 24476
interactions of polarized, with mesons (π^+) at 250 Mev, 18: 24404 (UCRL-11149)
interactions with neutrons at 23 Mev, 18: 24625 (WASH-1046)
interactions with protons, 18: 24625 (WASH-1046)
interactions with mesons (π^-), gamma angular distributions in, 18: 24417
interactions with mesons (π^-), multiple meson (π) production in, 18: 24418
interactions with protons at 142 and 143 Mev, mesons (π)-nucleon coupling constants from, 18: 24423
interactions with protons, elastic differential cross sections for, 18: 24424
interactions with mesons (π^+), elastic differential cross sections for, 18: 24424
interactions with gamma radiation at 950 to 1050 Mev, Λ^0 polarization in, 18: 24428
interactions with mesons (π) at high energies, fundamental lengths in, 18: 24436
interactions with photons, mesons (η) production in, 18: 24438
interactions with mesons (K^+) at 3 Bev/c, mechanism of ($K^0\pi^+p$) production in, 18: 24449
interactions with deuterons and protons at 210 Mev, polarization corrections in quasifree inelastic, 18: 24450
interactions with mesons (π^+) at 500 to 1600 Mev, cross sections for, 18: 24453
interactions with mesons (π^-) at 500 to 1000 Mev, cross sections for, 18: 24454
interactions with hyperons (Ξ^-) at low energies, 18: 24460
interactions with antiprotons, deuterons, and gamma rays, meson (π) production in, 18: 24474
interactions with mesons (π^-) at 7 to 8 Bev/c, hyperon (Λ) resonances in, 18: 24387 (JINR-P-1615)
interactions with protons at 315 Mev, spin correlation coefficients for elastic, 18: 24389 (JINR-P-1617)
interactions with protons at 7 to 20 Bev, diffraction-scattering, 18: 24392 (JINR-P-1632)
interactions with neutrons at 23.1 Mev, depolarization parameter for, 18: 24393 (LADC-6357)
interactions with protons at 10 to 30 Bev, differential cross sections for, 18: 24396(R) (NP-13947)
interactions with antiprotons and mesons (K^+) at 7 to 14 Bev/c, differential cross sections for elastic, 18: 24396(R) (NP-13947)
interactions with mesons (π^+) at 600 Mev, branching ratios and cross sections for, 18: 24396(R) (NP-13947)
interactions with mesons (π), W-boson production in, 18: 24397 (NP-13954)
interactions with neutrons, 18: 24400 (NYO-1807-9)
interactions with mesons (K^-), hyperon (Σ) leptonic decay in, 18: 244 (TID-19033)
interactions with nucleons near 140 Mev, phase-shift analysis of, 18: 24403 (UCRL-7563-T)
interactions with photons, meson (π) production in, 18: 24380 (DESY-64/3)
interactions with gamma radiation, meson production excitation curves for, 18: 24381 (ISS-64/4)
interactions with antiprotons and mesons (π) at high energies, dispersion relations for, 18: 24386 (JINR-P-1598)
interactions with protons at high energies, dispersion relations for, 18: 24386 (JINR-P-1598)
ionization reactions with gases, spark chamber studies of, 18: 24473
kinetic behavior in ice, 18: 23466
pairing with neutrons following proton-bombardment cascade in nuclei, perturbation theory for, 18: 24664
photoproduction on copper at 4 to 27 Mev, cross sections for, 18: 24698
polarization in elastic scattering by complex nuclei, 18: 24625 (WASH-

1046)
polarization in lanthanum magnesium nitrates, effects of neodymium-142 on, 18: 23444 (JINR-P-1626)
production in hydrogen in reactions with atoms and molecules at 10 to 180 kev, 18: 24324
properties in unitary symmetry model, electromagnetic, 18: 24388 (JINR-P-1616)
reactions (p,γ) with chromium-50 and -52, magnesium-50 and -52 energy levels from, 18: 24660
reactions (p,γ) with silicon-30 at 2 Mev, polarization in gamma spectra from, 18: 24662
reactions (p,d) with aluminum-27, perturbation theory for, 18: 24664
reactions (p,n) with vanadium-51 at 1.6 to 2.2 Mev, yields from, 18: 24591(R) (LMSC-4-50-62-1)
reactions (p,n) with titanium-46 at 7.2 to 9.5 Mev, excited states in vanadium-46 from, 18: 24612 (NP-13930(p.134))
reactions (p,n) with beryllium-9 at 45 to 95 Mev, spectra from, 18: 24642
reactions (p,γpxn) with europium, neodymium, and samarium, production of neutron-deficient radioactive rare earths in, 18: 24691
reactions and scattering of, distributions from, 18: 23948
reactions and scattering, 18: 24625 (WASH-1046)
reactions with bismuth, separation of products from, 18: 23732
reactions with hydrogen atoms, excited neutrals from charge-exchange, 18: 24757 (NP-13948)
reactions with hydrogen atoms, excited neutral from charge-exchange, 18: 24758 (NP-13949)
reactions with strontium oxide targets at 660 Mev, 18: 23731
scattering by cobalt and nickel isotopes, elastic, 18: 24625 (WASH-1046)
scattering by gadolinium-156 and holmium-165 at 17.5 Mev, coupled-channel analyses of, 18: 24666
scattering by heavy nuclei at 55 Mev, effects of deformation on optical potential for elastic, 18: 24665
scattering by polarized nuclei at 5 and 14 Mev, spin-spin interactions in, 18: 24645
spectra of high-energy geomagnetically trapped, in South Atlantic anomaly, 18: 24515 (UCRL-11409)
spectrum from deuteron–neutron interactions, 18: 24398 (NP-13961)

PROTOPLASM
stratification by centrifugation of nuclear, 18: 23197(R) (ANL-6823 (p.169-73))

PSEUDOUREA, 2-(2-AMINOETHYL)-2-THIO-
protective effects of, against radiation injuries in rats, synergistic effects of 2-imino-thiazolidine-4-carboxylic acid, 18: 23353(R) (NP-13918(p.42-57))
radiosensitivity effects on bean roots, 18: 23379

PSEUDOUREA, 2-ETHYL-2-THIO-
radiosensitivity effects on bean roots, 18: 23379

PSYCHOLOGY
radioinduced conditioned aversion to saccharin by rats, 18: 23236 (FSU-2690-15(Paper 2))
radioinduced conditioned aversion to saccharin by rats, 18: 23237 (FSU-2690-15(Paper 3))
radioinduced conditioned aversion to saccharin by rats, 18: 23238 (FSU-2690-15(Paper 4))
radioinduced conditioned aversion to saccharin by rats, 18: 23239 (FSU-2690-15(Paper 5))
radioinduced conditioned aversion to saccharin by rats, 18: 23240 (FSU-2690-15(Paper 7))

PULSE ANALYZERS
amplitude analysis for pulsed accelerators, use of storage tubes in, 18: 24021
amplitude-to-time converter for, linear gate and fast pulse-height coding system for, 18: 23852
analog-to-digital converter for, sliding-scale, 18: 23851
circuitry for pulse selection and registration unit for 100 megapulses/sec, 18: 24026
data processing for, computer-analyzer system for real-time reduction of multiparameter data, 18: 23860
data transmission from multichannel, to computers, 18: 24010
design and performance of nanosecond time selector with time-to-amplitude conversion and preselection, 18: 24016
design for pulse counting and measuring at 100 MHz and above, 18: 24029
design of nanosecond time coder for, 18: 24018
design of nanosecond time coder for, 18: 24019
design of nanosecond time coder for, 18: 24020
design of transistorized time-to-amplitude converter for, 18: 24017
design of 100-channel 500-nsec analog-to-digital converter for, 18: 24035
development of fast low-level pulse-height discriminator for semiconductor detectors, 18: 24031
discriminator circuit for rejection of gamma events in neutron spectroscopy using scintillators, 18: 23994
intermediate memory in pulse conditions, 18: 24011
micrologic elements for, 18: 23850
performance of magnetic-tape multidimensional, 18: 24012
pulse-height analysis accuracy at high rates, 18: 23856
pulse-time coder for neutron time-of-flight measurement, 18: 23996
spectrum stripping in multichannel, analog, 18: 24005
use of CDC 160-A computer for multiparameter-multichannel analysis for, 18: 23859
use of computer on-line with, for multiparammetric analyses, 18: 23858

PULSE GENERATORS (ELECTRONICS)
description of square-wave, with nanosecond length and steep front for spark counters, 18: 23843
design of high-recurrence nanosecond, using avalanche transistors, 18: 24027

PULSE MODIFIERS
design of window amplifier of 0.3 μsec risetime, 18: 23839 (PAN-479/I)

PUREX PROCESS
waste calcination and solidification, development of equipment and techniques for, 18: 24975(R) (HW-81829)

PYRIDINE COMPLEXES
with uranyl nitrates, infrared spectra and structure of, 18: 23535

PYRIDINE, VINYL-
radioinduced graft polymerization on polyoxymethylene, 18: 23607(T,R) (AEC-tr-6316(p.223-5))
radioinduced graft polymerization on cotton and rayon, gamma, 18: 23658(T,R) (AEC-tr-6316(p.650-9))
2-methyl-, radioinduced graft polymerization on polyvinyl alcohol fiber, 18: 23584(T,R) (AEC-tr-6316(p.79-83))
2-methyl-, radioinduced graft polymerization on polyethylene, 18: 23613(T,R) (AEC-tr-6316(p.266-73))
2-methyl-, radioinduced graft polymerization on polyethylene terephthalate, gamma, 18: 23657(T,R) (AEC-tr-6316(p.640-9))
5-ethyl-, radioinduced polymerization of, gamma, 18: 23633(T,R) (AEC-tr-6316(p.441))
5-methyl-, radioinduced graft polymerization on polyvinyl alcohol, gamma, 18: 23583(T,R) (AEC-tr-6316(p.76-8))

PYRIDINE, 4-VINYL-
radioinduced polymerization of, gamma, 18: 23632(T,R) (AEC-tr-6316 (p.440))

PYRIDINE, VINYL-, POLYMERS
radioinduced graft polymerization with polyvinyl chloride, gamma, 18: 23660(T,R) (AEC-tr-6316(p.672-5))

PYRIDOXINE
protective effects of isothiuronic derivatives of, against radiation injury in laboratory animals, 18: 23364(T) (JPRS-24817(p.15-17))

PYROPHOSPHATES
analysis for impurities in phosphorus-32 labeled, activation, 18: 23417
determination of phosphorus-32 labeled, in labeled phosphate solutions by activation, 18: 23417
purity of phosphorus-32 labeled, chromatographic and electrophoretic studies on, 18: 23417

PYRROLE
radioinduced polymerization, gamma, 18: 23597(T,R) (AEC-tr-6316 (p.154-62))

PYRROLIDONE, VINYL-
radioinduced graft polymerization on polyvinyl alcohol, gamma, 18: 23583(T,R) (AEC-tr-6316(p.76-8))
radiosensitivity effects on erythrocytes, 18: 23381

Q

QUALITY CONTROL
tracer techniques for, in manufacture of printed circuit boards, 18: 23841 (TID-20183)
QUANTOMETERS
design using multilayer ionization chamber for gamma energy measurements above 15 Mev, 18: 23899
QUANTUM MECHANICS
book: *Quantum Mechanics*, 18: 24513
book: *Quantum Scattering Theory. Selected Papers*, a collection of reprints, 18: 24512
book: *The Development of Weak Interaction Theory*, a collection of reprints, 18: 24514
charged-particle interactions with static vector potential in, Aharonov-Bohm paradox in, 18: 24503
coupling solution for model of Janner, Van Hove, and Verboven, 18: 24506
field theoretical model with superconducting solution in, 18: 24485
internal symmetries, review on, 18: 24379 (CONF-510-1)
operators in semi-simple groups in, invariant, 18: 24492
Regge trajectories, analytical properties of, 18: 24421
Regge trajectories for Coulomb potential, 18: 24430
S-operators of many-particle system, graphical representation of, 18: 24486
space-time variables in, critique of, 18: 24495
symmetry group coupling Lorentz group and SU$_3$, 18: 24496
theory of, conservation laws and symmetry in, 18: 24508
wave equation formulation in, relativistic, 18: 24490
wave functions for many-fermion systems, 18: 24461
QUARTZ
neutron scattering by lattice defects in irradiated, 18: 24194 (NP-13930 (p.116-17))
QUENCHING CIRCUITS
design for G-M counter with 12-μsec dead-time, 18: 23898

R

RABBITS
effects of infection on blood serum protein content in irradiated, 18: 23174
gastric ulcer formation in, effects of combined cortisone and x radiation on, 18: 23267
radiation effects on fatty acid metabolism in, gamma, 18: 23302
radiation effects on cerebral cortex activity in, x, 18: 23308
radiation effects on nerve structure in liver of, 18: 23309
radiation effects on gametes and zygotes in, 18: 23327
radiation effects on neuro-endocrine system, 18: 23377
radiation effects on, effects of procaine on, 18: 23384
radiation sickness in, protective effects of bacterial antigens against, 18: 23360(T) (JPRS-24704(p.1-5))
radioinduced leukopenia in, protective effects of theophylline and nucleic acids against, 18: 23373
retinal burns in, produced by electronically pulsed light source, 18: 23254
skin infection in irradiated, effectiveness of antibiotic therapy for, 18: 23315
RADIATION
biological effects of, protective effects of phenoxazine derivatives against, 18: 23378
detection and measurement in emulsions, effects of spurious tracks on, 18: 23936
detection and resolution by photographic film, 18: 23915
dose-effect curves for radium applicators, 18: 23396
dosimetry of mixed neutron and gamma beams, 18: 23813 (AERE-R-4528(p.49-53))
dosimetry, bibliographies on, 18: 23807 (AED-C-21-01)
effects of dose on tumorigenesis in mice, 18: 23231(R) (ANL-6823 (p.20-43))
effects on aging process in animals, 18: 23165 (BNL-854)
effects on bean roots, chemical protection against, 18: 23379
effects on gonads, 18: 23323
effects on hamster and rabbit gametes and zygotes, 18: 23327
effects on lipid synthesis, 18: 23301
effects on mercamine metabolism in liver and spleen of white rats, 18: 23304
effects on potassium-aluminoborate glass, additive, 18: 24813(R) (ANL-6880(p.49-67))
effects on potassium-aluminoborate glass, additive, 18: 24813(R) (ANL-6880(p.49-67))
effects on reproduction, conference on, 18: 23175
effects on sea urchin sperm, 18: 23339
effects on seeds of trees, 18: 23312
effects on soils and subsequent plant growth, 18: 23318
effects on yeasts, 18: 23311
genetic effects in wheat, 18: 23320
interactions with plasma, kinetic equations for, 18: 24789
leukopenia in rabbits induced by, protective effects of theophylline and nucleic acids against, 18: 23373
occurrence of mixed neutron and gamma beams in reactor areas, 18: 23813 (AERE-R-4528(p.49-53))
reactions with polystyrene, luminescence efficiency in, 18: 23662
tumorigenic effects in rodents, 18: 23349
RADIATION CHEMISTRY
isomerization of 2-butene induced on metallic oxides, 18: 23667
of acetone, 2-propanol, phthalates, and sulfuric acid aqueous solutions, uv spectra of transients in, 18: 23683
of acetylene, effects of argon, hydrogen, and pressure on formation of benzene in, 18: 23676
of solid methane at 77°K, formation of viscous polymeric oil in, 18: 23697
of water, mechanism of acidity and solute concentration effects on hydrogen yields in, 18: 23681
of 2-methylbutane and pentane, hydride ion transfer mechanism in, 18: 23677
RADIATION DETECTION INSTRUMENTS
book: *Semiconductor Counters for Nuclear Radiations*, 18: 23969
design for *in vivo*, for positron emitter display, 18: 23903
design of fast-timing-array, for determining arrival directions of cosmic showers, 18: 23965
development for coolant monitoring in GCR, 18: 24839(P)
development of transistorized, for neutron monitoring, 18: 23966
performance in determination of arrival direction of cosmic showers, 18: 24344
review of monitoring, 18: 23901
RADIATION DETECTION INSTRUMENTS (PULSE TYPE)
design and performance of fast, for measuring fission cross sections, 18: 24015
design for high energy electrons, 18: 23895
design of rocket-borne, for gamma measurements, 18: 23992
design of scintillation-type, for satellite studies of cosmic radiation, 18: 23988
design of, with optical and audio alarms, for work area monitoring, 18: 23889 (RT/EL(64)-1)
design with dose rate indicator, 18: 24040(P)
digital techniques for thermal neutron experiments, 18: 24004
pulse amplifiers for, gain stabilization of analog, 18: 24034
pulse-shape discrimination in proportional, 18: 23974
quenching circuit for G-M counter with 12-μsec dead-time, 18: 23898
RADIATION EFFECTS
on gel formation and viscosity of polyvinyl alcohol at high temperatures, 18: 24197(T,R) (AEC-tr-6316(p.114-17))
on gel formation in polyvinyl alcohol, 18: 24198(T,R) (AEC-tr-6316 (p.118-20))
RADIATION INJURIES
diagnosis of, by observations on amino acid content in blood serum, 18: 23319
in animal cells in tissue culture, reactivation by cell homogenates or DNA, 18: 23367
lethal effects of, in dogs, rats, and mice, 18: 23245 (UR-654)
of accessory sex organs in male hamsters, 18: 23336
of cells, mechanisms for, 18: 23316
of rabbit skin, protective effects of esculin against, 18: 23372
of rat embryos from injected strontium-90, 18: 23244 (UR-643)

- protection against, synergistic effects of 2-imino-thiazolidine-4-carboxylic acid with mercaptoethylamine, aminoisothiourea, and *p*-aminopropiophene, 18: 23353(R) (NP-13918(p.42-57))
- protection against, using sodium nitrate in mice, 18: 23356(R) (NP-13918(p.99-106))
- protection against, using *p*-aminopropiophenone, in mice, 18: 23357(R) (NP-13918(p.107-15))
- protection against, effects of diamide derivatives of imidazoledicarboxylic acids in, in laboratory animals, 18: 23362(T) (JPRS-24817(p.1-8))
- protection against, effects of isothiuronic derivatives of pyridoxine in laboratory animals, 18: 23364(T) (JPRS-24817(p.15-17))
- protection against, in plant cells, evaluation of various chlorides for, 18: 23374
- protection against, antibiotic, 18: 23380
- protection against, with amino compounds combined with thiols, 18: 23385
- to chromosomes of reproductive cells in mice, protective effects of streptomycin against, 18: 23359(T) (JPRS-24593(p.120-5))
- to eye lens in frogs, seasonal variations in, 18: 23268

RADIATION MONITORING
- design of radiation detection instrument with optical and audio alarms for, 18: 23889 (RT/EL(64)-1)
- equipment and techniques for, 18: 23901
- equipment for reactor coolant, 18: 24821 (HW-75374)
- in area of DIDO reactors, 18: 23811 (AERE-R-4538(p.25-33))
- processing and data recording system for film badges, semiautomatic, 18: 23818 (AWRE-O-93/63)

RADIATION PROTECTION
- from nuclear warfare, scenarios for, 18: 23821 (HI-303-RR)
- in storage areas for spent DIDO fuel elements, 18: 23814 (AERE-R-4528(p.55-67))
- of pregnant women during diagnostic x-ray examinations, 18: 23831

RADIATION SICKNESS
- effects on central nervous system in dogs, 18: 23310
- effects on cholesterol content of adrenal glands in rats, effects of treatment with cysteamine or adrenaline with acetylcholine on, 18: 23322
- effects on narcotic-induced sleep in rats, 18: 23363(T) (JPRS-24817 (p.9-14))
- effects on regeneration of nerves after traumatic injury, in dogs, 18: 23250(T) (JPRS-24704(p.12-17))
- protection against, effects of bacterial antigens in rabbits, 18: 23360(T) (JPRS-24704(p.1-5))
- protection against, in mice, by bone marrow injections after flu virus vaccination, 18: 23366

RADIATION SOURCES
- calibration, 18: 25004(R) (STI/DOC/10/25(p.9-69))
- preparation for beta spectroscopy, by electrolytic deposition of radioactive rare earths, 18: 24056

RADIATION TARGET CANS
- design, 18: 24907 (ORNL-TM-870)

RADIATION TARGETS
- reloading tritiated titanium, for D-T neutron sources, 18: 24579

RADIATORS
- design for nuclear space-craft, 18: 23779
- emissivity of materials for space, 18: 24138(R) (PWA-2206(Vol.I))
- emissivity of materials for space, 18: 24139(R) (PWA-2206(Vol.II))
- emissivity of materials for space, 18: 24140(R) (PWA-2206(Vol.III))

RADIO WAVES
- absorption in atmosphere, 18: 24516(T) (JPRS-24633)
- emission by antennas, measurement of, 18: 24516(T) (JPRS-24633)
- emission by auroral electrons at 1 to 7 Mcps, 18: 24537
- emission from moon at 50 cm, 18: 24516(T) (JPRS-24633)
- propagation in ionosphere, spiral distributions of blackouts and magnetic activity in, 18: 24525
- propagation of v-l-f, effects of high-altitude atomic explosions on ionospheric, 18: 24540

RADIOACTIVE GAS SEPARATION PROCESSES
- development of scrubbing techniques for, 18: 24979(T,R) (EURAEC-202)

RADIOACTIVE MATERIALS
- dividing and bottling solutions of, design of equipment and enclosures for, 18: 23757(P)

RADIOACTIVITY
- content in aquatic organisms, methods of expression for, 18: 23172
- detection of unidentified alpha, in thorite, 18: 23802
- induced in foods by x or gamma radiation, 18: 23815 (AERE-R-4601)
- measurement in liquids, method for, 18: 24041(P)
- measurements in Alaskan Eskimos, 18: 23834
- monitoring in vegetables in Osaka Prefecture, Oct. 1961 to Dec. 1963, 18: 23797

RADIOAPPLICATORS
- dosimetry for intracavity radium, 18: 23395
- isoeffect curves for radium, 18: 23396

RADIOBIOLOGY
- research activities at Argonne National Laboratory, January to June 1963, 18: 23161(R) (ANL-6823)
- research on development on radioprotective compounds at Air Force Radiation Lab., Jan. to April 1964, 18: 23166(R) (NP-13918)
- research on, in Ukrainian SSR, 18: 23169(T) (JPRS-24164)

RADIODIAGNOSIS
- of pancreatic diseases, 18: 23392
- sources for, methods for assaying iodine-125, 18: 23390

RADIOGRAPHY
- diagnostic, reduction of radiation dose from, during pregnancy, 18: 23831
- sensitivity for detection of defects in graphite, 18: 24146 (WADD-TR-61-72(Vol.XVII))
- spark chamber development for, self-triggering semiproportional, 18: 23976

RADIOISOTOPES
- activity standardization of "parent-daughter" mixtures, 18: 24042 (AERE-R-4555)
- decay of, spin relaxation in gamma angular correlations of, 18: 24653
- genetic effects of, incorporated in DNA, 18: 23298
- metabolism and toxicity in beagles, 18: 23184(R) (ANL-6823(p.44-75))
- production of delayed-proton emitting, possibility of, 18: 24736
- production of proton-emitting, 18: 24737
- radiation from, detection and resolution by photographic film, 18: 23915

RADIOLOGICAL WARFARE
- effects on ecology, historical examples related to, 18: 23179 (HI-303-RR/A1-2)
- effects on environment, input-output analysis of, 18: 23178 (HI-303-RR/A-III)
- effects on environment, scenarios for evaluating, 18: 23821 (HI-303-RR)
- effects on environment, 18: 23822 (HI-303-RR/A-IV)
- fatality estimates for three typical U. S. cities, effects of protective shelters on, 18: 23826 (NP-13942)

RADIOMETERS
- amplifiers in, use of low-noise, 18: 24516(T) (JPRS-24633)

RADIOMETRIC ANALYSIS
- equipment design for mixed-isotope, 18: 23886 (NP-13965)
- of air filter samples, quality control program for, 18: 23791(R) (NYO-10496(Add.))
- standardization of methods for, 18: 25004(R) (STI/DOC/10/25(p.9-69))
- use of least-squares method for beta and gamma, 18: 23434

RADIOMIMETIC SUBSTANCES
- genetic effects on mouse fertility, 18: 23177

RADIOPROTECTIVE COMPOUNDS
- effectiveness of esculin on rabbit skin, 18: 23372
- evaluation for protection of plant cells against alpha particles, 18: 23374
- evaluation in irradiated mice, 18: 23355(R) (NP-13918(p.75-98))
- evaluation of diamide derivatives of imidazoledicarboxylic acids as, in laboratory animals, 18: 23362(T) (JPRS-24817(p.1-8))
- evaluation of isothiuronic derivatives of pyridoxine in laboratory animals, 18: 23364(T) (JPRS-24817(p.15-17))
- evaluation of 23, in irradiated mice, 18: 23354(R) (NP-13918(p.58-74))
- properties of bean root, 18: 23379
- properties of phenoxazine derivatives, 18: 23378

RADIOSENSITIVITY
- of chick embryos, gamma, 18: 23229(R) (ANL-6823(p.5-14))
- of enzyme systems in rat liver, effects of steroids on, 18: 23352(R) (NP-13918(p.28-41))
- of male primordial germ cells and spermatogonia in rats, 18: 23331

of mice, effects of strain on, 18: 23251(T) (JPRS-24803)
of *Micrococcus radiodurans*, extraction of factor for, 18: 23222
of rat oöcytes and oögonia, 18: 23340

RADIOSTERILIZATION
of meat, storage following, 18: 23271
of meats, feasibility of, 18: 23272

RADIOTHERAPY
cataract-induction by, 18: 23313
cesium-137 sources for, 18: 23389
of tumors, effects on sodium thiocyanate space, 18: 23285
radium radiation source calibration for, 18: 23387 (ISS-64/2)
x-ray dose measurements in vicinity of interface between two media of different atomic compositions, 18: 23388

RADIUM
applicators, dosimetry for intracavity, 18: 23395
isoeffect curves for applicators of, 18: 23396
separation from clays by leaching with calcium chloride and sodium bicarbonate solutions, 18: 23711

RADIUM ISOTOPES
determination in bone, radiochemical, 18: 23402 (AERE-R-4466)

RADIUM ISOTOPES Ra-226
decontamination of clothing contaminated with, method for, 18: 23830
determination in drinking and river waters and urine by ion exchange, 18: 23421

RADON
content in atmosphere, meteorological effects on distribution of, 18: 24213
sorption by activated charcoal in presence of foreign gases, 18: 23462(T) (SC-T-64-616)
sorption by activated charcoal in open system of free gas flow, 18: 25031(T) (SC-T-64-617)

RADON ISOTOPES Rn-222
content in Swedish food, 1962, 18: 23790 (NP-13828)

RAFFINOSE
radioinduced free radicals in, gamma, 18: 23651(T,R) (AEC-tr-6316 (p.573-86))

RAIN WATER
fallout monitoring in Osaka Prefecture, 1963, 18: 23793
particle deposition from atmosphere in, tracer studies of, 18: 24212 (HW-SA-3167)

RARE EARTH ALLOYS
magnetic properties of, effects of crystalline field and structure on, 18: 24186
with transition metals, effects of atomic number on Laves phases in, 18: 24126 (CONF-405-32)
Po–rare earths, preparation and properties, 18: 24127 (CONF-405-33)

RARE EARTH COMPOUNDS
magnetic properties of, effects of crystalline field and structure on, 18: 24196

RARE EARTH FLUORIDES
complexes with sodium fluoride, phase studies, 18: 23441 (CONF-405-40)

RARE EARTHS
deposition of radioactive, on metal, for use as radiation source, 18: 24056
ion reactions with, particle charge distributions from heavy, 18: 24624 (UCRL-10806)
ion-exchange and solvent-extraction properties of, compared with actinides, 18: 23699 (CONF-405-37)
magnetic properties of, antiferro- and ferro-, 18: 24178
separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)
separation by paper-phase partition chromatography, 18: 23709(T) (JPRS-24552(p.57-9))
separation by paper chromatography using Di-(2-ethylhexyl) *ortho*phosphoric acid, 18: 23715
separation from actinides, chromatographic, 18: 23722
separation from irradiated aluminum–plutonium alloys by ion exchange, 18: 23702 (ORNL-3566)
separation of europium from, chromatographic, 18: 23723
yields of neutron-deficient radioactive, from proton reactions with europium, neodymium, and samarium, 18: 24691

RARE GASES
effects on grain-boundary mobility, 18: 23566

RATE METERS
design with audible indicator, 18: 24040(P)
performance for gamma and x rays, 18: 23967

RATS
calcium-45 and strontium-85 retention in, effects of tetracycline on, 18: 23220
effects of estrogenic hormones on seminiferous tubules in, comparison of, with radiation effects, 18: 23332
effects of lipines on radioiodinated antibody and fibrinogen deposition in, 18: 23219
effects of radiation sickness on cholesterol content of adrenal glands in, 18: 23322
effects of sex hormones on endogenous respiration in x-irradiated testes of, 18: 23333
excretion of taurine and sulfate by, effects of adrenal hormones on, 18: 25006 (TID-18927)
iodine-131 content in skin and hair of, 18: 23207(T) (JPRS-24704 (p.6-11))
neptunium-237 and plutonium-239 distribution and retention in adrenals of, 18: 23221
niobium poisoning in, effects on kidney function, 18: 23203 (UR-646)
pathological effects of injected strontium-90 in developing embryos of, 18: 23244 (UR-643)
radiation effects on oxidative phosphorylation in liver mitochondria of, x, 18: 23233(R) (ANL-6823(p.157-60))
radiation effects on urinary excretion of creatine and 2-methyl-β-alanine in, 18: 23234 (EUR-591.d)
radiation effects on enzyme activity in liver of, 18: 23241(R) (NP-13918(p.13-27))
radiation effects in, lethal, 18: 23245 (UR-654)
radiation effects on amino acid incorporation by proteins of thymus cell nuclei of, x, 18: 23259
radiation effects on thyroid growth function of, measurement techniques for, x, 18: 23260
radiation effects on growth of injected epitheliomas in, x, 18: 23264
radiation effects on bone marrow of, x, 18: 23265
radiation effects on pituitary oxytocin content of, x, 18: 23275
radiation effects on lifespan of, effects of age at irradiation on, fast neutron, 18: 23292
radiation effects on uptake of carbon-14-labeled methionine by tissues of, x, 18: 23293
radiation effects on hematology in, x, 18: 23296
radiation effects on fatty acid metabolism in, gamma, 18: 23302
radiation effects on mercamine metabolism in liver and spleen in, 18: 23304
radiation effects on reproduction in, gamma, 18: 23328
radiation effects on seminiferous tubules in, comparison of, with effects of estrogenic hormones, 18: 23332
radiation effects on various stages of oögenesis in, 18: 23340
radiation effects on reproduction in, gamma, 18: 23343
radiation effects on duration of narcotic-induced sleep in, 18: 23363(T) (JPRS-24817(p.9-14))
radiation effects on hematopoietic system of, x, 18: 23376
radiation effects on urinary excretion of deoxycytidine by, 18: 23382
radiation effects on, effects of carbon oxide on, 18: 23383
radiation- and hydrocarbon-induced tumors in, 18: 23349
radioinduced conditioned aversion to saccharin by, 18: 23236 (FSU-2690-15(Paper 2))
radioinduced conditioned aversion to saccharin by, 18: 23237 (FSU-2690-15(Paper 3))
radioinduced conditioned aversion to saccharin by, 18: 23238 (FSU-2690-15(Paper 4))
radioinduced conditioned aversion to saccharin by, 18: 23239 (FSU-2690-15(Paper 5))
radioinduced conditioned aversion to saccharin by, 18: 23240 (FSU-2690-15(Paper 7))
radioinduced islet tumors in parabiosed, x, 18: 23286
radioinduced mammary and pituitary tumors in, astatine-211, 18: 23261
radioinduced saccharin avoidance in, effects of postirradiation fluids on, x, 18: 23290

radioinduced tumors in, plutonium, 18: 23232(R) (ANL-6823(p.81-5))
radiosensitivity of male primordial germ cells and spermatogonia in, 18: 23331
radiosensitivity of enzyme systems in liver of, effects of steroids on, 18: 23352(R) (NP-13918(p.28-41))
soluble nuclear proteins in liver of, factors affecting, 18: 23192(R) (ANL-6823(p.124-7))
strontium-90 content in, effects of calcium-rich diet during lactation on, 18: 23216
strontium-90 distribution and retention in tissues of, effects of age, dose, and administration route on, 18: 23243 (UR-642)
toxic effects of 2-mercaptoethylamine in, chemical modification of, 18: 23202(R) (NP-13918(p.1-12))
uptake of sulfur-35-labeled methionine by blood serum of, 18: 23247(T) (JPRS-24164(p.1-8))

REACTION MECHANISMS
analysis of vapor plating, computer programs for, 18: 23451 (UCRL-7667)

REACTOR BREEDING ELEMENTS
design, 18: 24929(P)
processing of, method for, 18: 24929(P)

REACTOR COMPONENTS
containment vessels, stress analysis of thin-shell, 18: 24824(R) (TID-20613)

REACTOR CONTROL ELEMENTS
design and testing of hydraulic-ball-controlled, 18: 24820(R) (GNEC-337)
drive for drum, development of, 18: 24908 (PWAC-412)

REACTOR CONTROL RODS
actuator development for Maritime Nuclear Steam Generator, 18: 24939(R) (GEMP-285)
design of pneumatic brake for, 18: 24834(P)
development and testing for SGR, 18: 24891(R) (NAA-SR-8888(Sect.I))
drive for, electromotive, 18: 24841(P)
fabrication and properties of boron carbide, 18: 24974
radiation effects on stainless steel-clad boron–iron systems, 18: 24195 (ORNL-TM-815)

REACTOR CONTROL SYSTEMS
circuits for, review on, 18: 24826
circuits of, annunciator for, 18: 24887 (HW-80921)
design and testing of hydraulic-ball, 18: 24820(R) (GNEC-337)
development for Maritime Nuclear Steam Generator, 18: 24939(R) (GEMP-285)
development for water-moderated, suspension-fueled reactors, 18: 24842(P)
development of shaped charges containing poison for, 18: 24876 (APEX-142)
reactivity auto-oscillations calculations for, small-amplitude, 18: 24850 (NP-13963)
testing of armature and scram spring housing in, hydrostatic-burst metallurgical, 18: 24890 (MND-M-3088 & Add.1)
use of computers and data processing systems in, 18: 24828

REACTOR COOLANTS
boiling of organic, void formation and heat transfer mechanisms during transient, 18: 24816(R) (NAA-SR-8888(Sect.IV))
monitoring for arsenic-76 content, automatic system for, 18: 24821 (HW-75374)
monitoring for fission fragments, equipment for, 18: 24839(P)
monitoring purity of, system for, 18: 24932 (HW-SA-3018)
neutron moderation in water, 18: 24888 (HW-SA-3507)
pressure transients in, effects on heat transfer and hydraulics, 18: 24816(R) (NAA-SR-8888(Sect.IV))
radioactivity release in, from oxide films on alloys, 18: 24082 (HW-79811)
reactions of steam and water, with fuel pins during excursions, 18: 23817(R) (ANL-6880(p.72-8))
reactivity void coefficients of sodium, 18: 24813(R) (ANL-6880 (p.49-67))

REACTOR COOLING SYSTEMS
boiling in channels in, equations for vapor fractions in, 18: 23769 (TID-19075)
circulators for A.V.R. Brown Boveri-Krupp, primary, 18: 24912 (TID-7690(p.1-15))
decontamination, 18: 24958 (NP-13907)
design for concrete pressure vessels, 18: 24830(P)
design for steam-cooled reactors, 18: 24930(P)
expansion-joint design for, 18: 24835(P)
flow control in liquid-metal, 18: 24935 (APEX-260)
hazards evaluation in STEP project, 18: 24956(R) (IDO-16961)
liquid-pressure regulator for, design of, 18: 23867(P)
testing cooling-down system for loops in, 18: 24881 (DLCS-4140301)

REACTOR ENGINEERING
book: *Structures for Nuclear Power,* 18: 24926
commissioning procedures for, 18: 24810 (AEET/ROD/10)
development at ANL, summary, 18: 24812(R) (ANL-6880)
stress analysis of thin-shell containment vessels, 18: 24824(R) (TID-20613)

REACTOR EXPERIMENTAL FACILITIES
lattice parameters of graphite thermal columns, 18: 24865(T,R) (EURAEC-992)

REACTOR FUEL ALLOYS
development for fast, liquid-metal-cooled reactors, 18: 24952(R) (ANL-6880(p.6-48))
development for zero-power experimental reactors, 18: 24952(R) (ANL-6880(p.6-48))
processing fissium–plutonium–uranium, methods for, 18: 24952(R) (ANL-6880(p.6-48))

REACTOR FUEL ELEMENTS
analysis of, radiochemical, 18: 25004(R) (STI/DOC/10/25(p.9-69))
burnout in boiling reactors, protection against, 18: 24924
burnup testing of clad uranium dioxide, 18: 24855(R) (GEAP-3771-12)
cladding development and testing for sodium-cooled reactors, 18: 24891(R) (NAA-SR-8888(Sect.I))
cycle analysis using FUEL CYC code, 18: 24904 (NP-13904)
design for low pressure losses, 18: 24872(P)
design of helically finned, 18: 24869(P)
design of stabilized, in coolant flow, 18: 24870(P)
design of thick-finned "vapotron", for boiling reactors, 18: 24862(T,R) (EURAEC-541)
design of thick-finned "vapotron", for boiling reactors, 18: 24863(T,R) (EURAEC-694)
design of thick-finned "vapotron", for boiling reactors, 18: 24864(T,R) (EURAEC-770)
design with thermocouple, 18: 24871(P)
development and testing of nuclear-superheat, 18: 24884(R) (GEAP-4419)
development and testing of nuclear-superheat, 18: 24886(R) (GEAP-4565)
development for heavy-water reactors, 18: 24882(R) (DP-905)
development of fission-electric, 18: 24372(R) (TID-20575)
development of high-power-density, 18: 24885(R) (GEAP-4488)
fabrication of plutonium, radiological control of, 18: 23824 (HW-81363)
fabrication of sheathed, to prevent movement between fuel and sheath, 18: 24116(P)
failure in reactors, detection system for, 18: 24836(P)
failure in reactors, detection system for, 18: 24837(P)
failures of, detection systems for, 18: 24925
handling device for unloading, 18: 24832(P)
handling in reactors, design of gas-operated grabhead for, 18: 24833(P)
handling plutonium-bearing, methods for, 18: 24865(T,R) (EURAEC-992)
heat transfer characteristics of crossed rod matrices, effects of moderator blocks in air stream on, 18: 23764 (APEX-724)
processing of irradiated, by chloride volatility methods, 18: 23704 (ORNL-TM-828)
processing of irradiated, tritium disposal in wastes from, 18: 24978 (ORNL-TM-851)
processing of irradiated, solvent purification for, 18: 23698 (CEA-R-2404)
storage of spent DIDO, 18: 23814 (AERE-R-4528(p.55-67))
temperature in multi-tube, method for calculating, 18: 24867
testing for leaks, 18: 24958 (NP-13907)
welding method for end caps on sheathed, 18: 24113(P)
welding of plutonium-containing, 18: 24100 (HW-SA-3146)

REACTOR FUEL ELEMENTS (CERAMIC)
coating of uranium dioxide particles for, for pebble-bed reactors, 18: 24115(P)
development for high-temperature high-burnup ASCR, 18: 24891(R) (NAA-SR-8888(Sect.I))
development of uranium dioxide, 18: 24893(R) (NAA-SR-8888(Sect.III))
development of uranium-carbide, 18: 24860(R) (UNC-5071)
fabrication and properties of internal conversion, 18: 24065(R) (GEMP-34A)
fabrication of uranium carbide, for Sodium Graphite Reactor, cost analysis of, 18: 24095 (AI-8700(Vol.I))
fabrication of uranium carbide, by skull casting, 18: 24097 (AI-8700 (Vol.III))
fabrication of uranium carbide, for sodium graphite reactor, 18: 24098 (AI-8700(Vol.IV))
fabrication of uranium carbide, 18: 24892(R) (NAA-SR-8888(Sect.II))
processing, 18: 23701(R) (NAA-SR-8888(Sect.V))
radiation effects on wire-type uranium dioxide, 18: 24189 (APEX-730)
separation from plutonium and uranium by fluoride volatility, 18: 24813(R) (ANL-6880(p.49-67))
testing uranium-dioxide, for water reactors, 18: 24854(R) (CEND-2863-211)

REACTOR FUEL ELEMENTS (DISPERSION)
fission gas release from graphite-supported alumina-, beryllia, and pyrolytic carbon-coated uranium dicarbide and dioxide, 18: 24988(R) (BMI-1665(Del.))
processing of graphite-supported alumina-coated uranium dioxide, effects of fabrication techniques on, 18: 24988(R) (BMI-1665(Del.))

REACTOR FUEL ELEMENTS (THERMOELECTRIC)
development for naval reactors, summary, 18: 24857(R) (GEST-2031)
development of, 18: 24369(R) (NP-13892)
properties, 18: 24927

REACTOR FUEL PINS
meltdown of uranium carbide, during TREAT excursions, 18: 23817(R) (ANL-6880(p.72-8))
reactions with coolant steam and water during excursions, 18: 23817(R) (ANL-6880(p.72-8))

REACTOR FUEL PLATES
testing of, pressure-deflection, 18: 24963 (TID-20621)

REACTOR FUEL RODS
radiation effect on strain and stress distributions in, fast neutron, 18: 24943

REACTOR FUEL SHEETS
creep and corrosion tests on chromium–nickel, 18: 24939(R) (GEMP-285)

REACTOR FUEL TUBES
development of uranium-dioxide, 18: 24882(R) (DP-905)
testing 347 stainless steel, containing uranium dioxide, 18: 24854(R) (CEND-2863-211)

REACTOR FUEL WIRES
radiation effects on nichrome-clad uranium dioxide, 18: 24189 (APEX-730)

REACTOR FUELS
burnup of, development of methods for determining, 18: 24856(R) (GEAP-4430)
compaction of, parameters for vibratory, 18: 24952(R) (ANL-6880(p.6-48))
costs of enriched-uranium, effects of toll enrichment on, 18: 24866
costs of molybdenum–silicon–uranium, in organic-moderated reactors, 18: 24859 (TID-20593)
development of coated-particle, 18: 24988(R) (BMI-1665(Del.))
development of, Euratom–U. S. joint research for, 18: 25036
economics of plutonium, thorium, and uranium, 18: 24858(R) (HW-80560F)
grain size testing of, standardization and evaluation of ultrasonic equipment for, 18: 24132 (HW-61752)
handling plutonium-bearing, methods for, 18: 24865(T,R) (EURAEC-992)
meltdown of uranium carbide, during TREAT excursions, 18: 23817(R) (ANL-6880(p.72-8))
preparation of plutonium dioxide–uranium dioxide, 18: 24868(P)
processing ceramic, by fluoride volatility methods, 18: 24813(R) (ANL-6880(p.49-67))
separation from praseodymium, solvent-extraction, 18: 24952(R) (ANL-6880(p.6-48))
testing of uranium-carbide-pellet, 18: 24072(T,R) (EURAEC-934)
testing uranium-dioxide, for water reactors, 18: 24854(R) (CEND-2863-211)

REACTOR FUELS (FUSED SALTS)
reactions with graphite, 18: 24907 (ORNL-TM-870)

REACTOR MATERIALS
analysis of, radiochemical, 18: 25004(R) (STI/DOC/10/25(p.9-69))
book: *Structures for Nuclear Power*, 18: 24926
development of alloys and ceramics as, 18: 24815(R) (MLM-1184)
development of, Euratom–U. S. joint research for, 18: 25036

REACTOR MATRICES
buckling and reaction rates in plutonium-graphite, 18: 24852
heat transfer by crossed-rod screen type, up to 2000°F and 9 kw/in.³, 18: 23764 (APEX-724)
neutron collision probability codes for cylindrical lattices, 18: 2484 (ANL-6836)
neutron two-group space-time diffusion in slab, 18: 24572 (WAPD-TM-416)
power and steam-void distributions in three-fuel-zone Hy-Ball core, 18: 24820(R) (GNEC-337)

REACTOR MODERATORS
design for heterogeneous reactors, 18: 24838(P)
performance of graphite-water, 18: 24888 (HW-SA-3507)

REACTOR REFLECTORS
cold neutron production by, 18: 24569 (NP-13930(p.119-20))

REACTOR SAFETY
analysis of Maritime Nuclear Steam Generator, 18: 24939(R) (GEMP-285)
control of, British research reactors, 18: 23810 (AERE-R-4528 (p.1-24))
hazards from accidental fission product release, 18: 23816 (AHSB(S)R-64)
heat transfer effects in moderate accidents, 18: 24817 (NDA-14-134)
manual for operation of Experimental Gas Cooled Reactor, 18: 23820 (EGCR-4)
period safety excursions during startup, 18: 24814 (CEA-R-2411)
policies for, 18: 23832
research at Atomics International, 18: 24816(R) (NAA-SR-8888 (Sect.IV))
stress analysis of thin-shell containment vessels, 18: 24824(R) (TID-20613)

REACTOR SAFETY EXPERIMENTS
design and development of LOFT, 18: 24956(R) (IDO-16961)
fuel element testing in TREAT, transient heating, 18: 24891(R) (NAA-SR-8888(Sect.I))
hazards evaluation of SNAP 2/10A in STEP, 18: 24956(R) (IDO-16961)
operation of SPERT I, II, III, and IV, July–Sept. 1963, 18: 24955(R) (IDO-16931)
operation of TREAT, 18: 23817(R) (ANL-6880(p.72-8))
power excursion tests of SPERT from 1955 to 61, transient pressure measurements for, 18: 24954 (IDO-16930)

REACTOR SHIELDING
design for coolant flow across shield, 18: 24843(P)
requirements for ANP program, 18: 24934 (ANP-53)

REACTOR SIMULATORS
design for nuclear seaplane power plant, 18: 24935 (APEX-260)
two-dimensional dynamic, 18: 24847 (HW-79446)

REACTOR THERMAL COLUMNS
neutron temperature measurements in Russian VVR-S, 18: 24970

REACTORS
commissioning procedures for, 18: 24810 (AEET/ROD/10)
compressors for, construction and operation of gas-bearing, 18: 23744 (TID-7690(p.219-35))
containment vessels for, stress analysis of thin-shell, 18: 24824(R) (TID-20613)
control rod drive for, electromotive, 18: 24841(P)
development at ANL, summary, 18: 24812(R) (ANL-6880)
development of, Euratom–U. S. joint research for, 18: 25036
eigenvalue calculations for, using the Monte Carlo method, 18: 24818 (WAPD-T-1649)

fuel costs in, effects of toll enrichment agreements on, 18: 24866
fuel depletion analysis of plutonium-containing, 18: 24861 (WCAP-6060)
kinetics of coupled-core, analysis of, 18: 24848 (LAMS-2967)
neutron flux distribution in, activation method for determining, 18: 24840(P)
neutron flux mapping in, apparatus for, 18: 24827
neutron flux measurements in, using pellets, 18: 24829(P)
pressure vessels for, properties of prestressed concrete, 18: 24825
pressure vessels for, design of cooling system for concrete, 18: 24830(P)
radiation effects on pressure vessels of, measurement of, 18: 23780(R) (SWRI-1243-11)
reactivity auto-oscillations calculations for, small-amplitude, 18: 24850 (NP-13963)
reactivity transients from pulsed source operation and step changes, 18: 24851 (ORNL-TM-570)
safety policies for Bodega Bay, 18: 23832
simulation of, two-dimensional dynamic analog, 18: 24847 (HW-79446)
startup measurements, 18: 24921
startup of, period safety excursions during, 18: 24814 (CEA-R-2411)

REDOX PROCESS
waste calcination and solidification, development of equipment and techniques for, 18: 24975(R) (HW-81829)

REDUCTION
thermodynamics of, computer code for, 18: 23451 (UCRL-7667)

REFRACTOMETERS
design and operation of neutron, 18: 23838 (NP-13930(p.122-4))

REFRACTORY COATINGS
development for Haynes 25 Alloy and type 316 stainless steel, 18: 24085(R) (NASA-CR-54053)
emissivity of, on spacecraft radiator materials, 18: 24138(R) (PWA-2206 (Vol.I))
emissivity of, on spacecraft radiator materials, 18: 24139(R) (PWA-2206(Vol.II))
emissivity of, on spacecraft radiator materials, 18: 24140(R) (PWA-2206(Vol.III))

REFRIGERATION
development of pulsed, for cryogenic magnet cooling, 18: 24544(R) (NBS-8253)
equipment for thermoelectric, 18: 24376

RELATIVITY THEORY
acausality and dispersion relations, 18: 24383 (JINR-E-1646)
Lorentz invariance of S-matrix in general, gauge invariance and equivalence from, 18: 24501
relation of massive highly condensed objects to astrophysics, 18: 24277
review, 18: 24491
space-time variables in, critique of, 18: 24495

REMOTE-CONTROL EQUIPMENT
design for dividing and bottling radioactive solutions, 18: 23757(P)
design of grabhead for handling fuel elements in a reactor, 18: 24833(P)
design of pipetters for hot cells, 18: 23842 (UCRL-9661)
sealing and shielding of, 18: 23753 (AERE-R-4085)

REPTILES
effect of large underground thermonuclear explosion on lizard population of test site, 18: 23181 (UCLA-12-522)

RESEARCH REACTORS
commissioning procedures for, 18: 24810 (AEET/ROD/10)
control rods for ANNA, 18: 24974
description and operation of ISPRA-2, 18: 24962 (RT/ING(63)-25)
design of Cabri, 18: 24969
design of CESAR, 18: 24968
facilities and uses of Avogadro RSI, 18: 24972
gamma and neutron spectra in ASTRA, effects of dividing core by moderator material on, 18: 24849 (NP-13930(p.130))
gamma dose and neutron flux measurements at TRIGA F, 18: 24957 (NDL-TR-59)
neutron temperature measurements in graphite thermal column of VVR-S, 18: 24970
nuclear physics research using FRM, 18: 24961 (NP-13930(p.80-103))
occurrence of mixed neutron and gamma beams in reactor areas, 18: 23813 (AERE-R-4528(p.49-53))
operation of Canada-India, 18: 24949 (AEET/ROD/7)
operation of, administrative and organizational problems in, 18: 24950 (AEET/ROD/9)
operations of Borax-V, summary, 18: 24951(R) (ANL-6880(p.1-5))
operations of VVR-M, 18: 24958 (NP-13907)
performance of Canada-India Reactor, 18: 24948 (AEET/ROD/6)
performance of IRT-2000, 18: 24960 (NP-13911)
reactivity studies in High Conversion Critical Experimental Facility, 18: 24813(R) (ANL-6880(p.49-67))
role in nuclear power program, 18: 24973
stability of L54M at CESNEF, 18: 24971

RESINS
development of scintillating, for beta emitters in volume solutions, 18: 23975
performance of Colophony, for reduction of nuclear emulsion distortion during development, 18: 23556
selectivity of phosphoric acid, for cesium, lithium, potassium, rubidium, and sodium as function of acidity, 18: 23481

RESISTANCE THERMOMETERS
calibration of, for Shippingport Pressurized Water Reactor, 18: 24918 (WAPD-PWR-TE-159(Rev.))

RESISTORS
radiation effects on, neutron, 18: 24822 (PWAC-427)

RESPIRATION
effects of sex hormones on, of x-irradiated rat testes, 18: 23333

RHENIUM
content of stony meteorites, 18: 24292
deposition by pyrolysis and reduction, analysis of, 18: 23451 (UCRL-7667)
performance in thermionic cells, effects of additives on, 18: 24350(R) (AD-418276)

RHENIUM ALLOYS
Mo–Re, hydrogen affinity of, 18: 24165
Nb–Re, electric and mechanical properties, 18: 24158
Nb–Re, hydrogen affinity of, 18: 24165
Nb–Re–W, factors affecting vacuum-arc melting of, 18: 24070 (RTD-TDR-63-4089)
Re–W, fabrication and properties of drawn and extruded tubular, 18: 24066(R) (NMI-2126)
Re–W, fabrication and properties of drawn and extruded tubular, 18: 24067(R) (NMI-2127)

RHENIUM CHLORIDES
pyrolysis of, rhenium plating by, 18: 23451 (UCRL-7667)
reduction by hydrogen, rhenium plating by, 18: 23451 (UCRL-7667)

RHENIUM COUPLES
Mo–Re/Re, development of thermocouples of, 18: 24937 (APEX-917)
Re–W/W, development of thermocouples of, 18: 24937 (APEX-917)

RHENIUM FLUORIDES
pyrolysis of, rhenium plating by, 18: 23451 (UCRL-7667)
reduction by hydrogen, rhenium plating by, 18: 23451 (UCRL-7667)

RHENIUM SILICIDES
shear modulus and sound velocity of, 18: 24174

RHODIUM
oxygen reactions (O-16,F-18) at 160 Mev, distorted wave analysis of, 18: 24719

RHODIUM ALLOYS
Fe–Rh, magnetic transformations in, neutron diffraction study of, 18: 24166
Fe–Rh, magnetic moments and unpaired spin densities in, 18: 24169

RHODIUM ISOTOPES Rh-101
gamma spectra of metastable, 18: 24585(R) (IDO-16969)

RHODIUM ISOTOPES Rh-103
neutron capture, 18: 24625 (WASH-1046)

RHODIUM ISOTOPES Rh-106
separation by calcium phosphate–humic acid flocculation, 18: 24982

RHODIUM SULFATES
use as thermal neutron monitor, 18: 23896

RIBONUCLEASE
radiation effects on, gamma, 18: 23295

RIBONUCLEIC ACID
radiation effects on bean seed, gamma, 18: 23252(T) (ORNL-tr-84)

RIBONUCLEIC ACID, DESOXY-

- genetic code of, role of peptides in, 18: 25011 (TID-20348)
- isolation and properties of, 18: 25011 (TID-20348)
- radiation effects on bean seed, gamma, 18: 23252(T) (ORNL-tr-84)
- radiation effects on content of saline-soluble, in mouse spleen, 18: 23257
- radiation effects on structural and regulatory mechanisms of, in phages, 18: 23269
- radiation effects on, incorporated radioisotope, 18: 23298
- reactivation of irradiated mouse L cells by, 18: 23367
- synthesis in isolated tumor cells, effects of tritium on, 18: 23215

RIBOSE
- radioinduced free radicals in, gamma, 18: 23651(T,R) (AEC-tr-6316 (p.573-86))

ROCKET MOTOR NOZZLES
- development and testing of cooled and uncooled, for nuclear systems, 18: 24940 (NASA-CR-54000)
- fabrication of pyrolytic-graphite, 18: 24114(P)

ROCKET MOTORS
- development of cesium-ion, summary, 18: 23740(R) (NP-13899)

ROCKET REACTORS (KIWI)
- testing of B-1B, summary report, 18: 24938 (EGG-L-603)

ROCKETS
- instrumentation for, gamma-ray, 18: 23992
- nozzle development and testing for nuclear, 18: 24940 (NASA-CR-54000)

ROOTS
- radiation effects on bean, protective effects against, 18: 23379

RUBBER
- radiation effects on, gamma and neutron, 18: 24937 (APEX-917)
- radioinduced cis-trans transformation of natural, effects of sensitizers on, 18: 23636(T,R) (AEC-tr-6316(p.444-8))
- radioinduced crosslinking of natural, effects of sulfur dioxide on gamma, 18: 23637(T,R) (AEC-tr-6316(p.449-55))
- radioinduced free radicals in, singlets in electron spin resonance spectra produced at high doses, 18: 23616(T,R) (AEC-tr-6316(p.306-9))

RUBIDIUM
- content in deep crustal material, 18: 23801
- content of soil, effects on rubidium-86 diffusion and uptake by soil, 18: 23227
- separation from cesium by electrophoresis in ammonium pamtungstate, tracer studies of, 18: 23729
- separation from cesium by electrophoresis, tracer studies of, 18: 23730
- sorption by phosphoric acid resins, effects of acidity on selectivity coefficients for, 18: 23481

RUBIDIUM AMIDES
- catalysis of isotopic exchange between liquid ammonia and hydrogen by, 18: 24058(P)

RUBIDIUM CHLORIDES
- electric conductivity of melts, temperature coefficients for, 18: 23456(T) (AI-Trans-46)
- proton relaxation times in aqueous solutions of, 18: 23559

RUBIDIUM ISOTOPES Rb-85
- mobility of ionic, in aqueous solutions of potassium nitrate at 25°C, 18: 23467

RUBIDIUM ISOTOPES Rb-86
- effects of soil moisture and rubidium concentration on diffusion and uptake of, 18: 23227

RUBIDIUM ISOTOPES Rb-87
- mobility of ionic, in aqueous solutions of potassium nitrate at 25°C, 18: 23467

RUBIDIUM URANYL PHOSPHATES
- solubility of, tracer studies of, 18: 23545

RUSSIAN REACTORS
- neutron temperature measurements in graphite thermal column of VVR-S, 18: 24970
- operations of VVR-M, 18: 24958 (NP-13907)
- performance of IRT-2000, 18: 24960 (NP-13911)

RUTHENIUM
- separation from irradiated uranium by ion exchange, 18: 23726
- separation from waste solutions by cellulose derivative-bentonite flocculation, 18: 24983
- superconductivity, 18: 24179

RUTHENIUM ALLOYS
- superconductivity, 18: 24179

RUTHENIUM ISOTOPES Ru-95
- gamma spectra, 18: 24585(R) (IDO-16969)

RUTHENIUM ISOTOPES Ru-103
- determination in mixed fission products, beta-gamma coincidence, 18: 23886 (NP-13965)

RUTHENIUM ISOTOPES Ru-106
- deposition on stainless steel in fuel element processing, 18: 23705 (ORNL-TM-837)
- determination in mixed fission products, beta-gamma coincidence, 18: 23886 (NP-13965)
- metabolism, 18: 23816 (AHSB(S)R-64)
- separation by calcium phosphate–humic acid flocculation, 18: 24982

RUTHENIUM OXIDES
- spectra in low frequency region, infrared, 18: 23549
- use as fixatives for electron microscopy, 18: 23162(R) (ANL-6823(p.174-7))

S

SACCHARIN
- radioinduced avoidance of, in rats, effects of postirradiation fluids on, x, 18: 23290

SACLAY PROTON SYNCHROTRON
- electronic complex for, description of fast transistorized, 18: 24266

SAFETY
- in plutonium fuel element fabrication facility, 18: 23824 (HW-81363)

SAFETY HAZARDS
- fire damage in shipping containers, requirements for simulation, 18: 23827 (NYO-2539-1)

SAINT LAURENT-DES-EAUX REACTOR (EDF-4)
- design, 18: 24920

SAMARIUM
- heat of solution in liquid tin at 750°K, 18: 24183
- heat of sublimation, 18: 23439 (CONF-405-36)
- magnetic properties of, effects of crystalline field and structure on, 18: 24186
- polarographic behavior in tetraethylammonium bromide at dropping mercury electrode, 18: 23463
- proton reactions (p,ypxn) at 660 Mev, production of neutron-deficient radioactive rare earths in, 18: 24691
- separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)
- vapor pressures at 1033 to 1302°K, 18: 23439 (CONF-405-36)

SAMARIUM CARBIDES
- electric conductivity and thermoelectric power at room temperature to 4°K, 18: 23511
- properties of, chemical and physical, 18: 23517

SAMARIUM CHLORIDES
- solubility of gypsum in aqueous solutions of, 18: 23536

SAMARIUM COMPLEXES
- with 2,2′-dipyridyl, preparation and fluorescence and infrared spectra of, 18: 23500

SAMARIUM IONS
- electron paramagnetic resonance in calcium fluorides, relaxation in, 18: 23526
- electron spin resonance in calcium fluorides, spectra of, 18: 23524

SAMARIUM ISOTOPES Sm-146
- buildup in reactors, compensation for, 18: 24853(P)

SAMARIUM ISOTOPES Sm-147
- proton elastic scattering at 55 Mev, effects of nuclear deformation on, 18: 24665

SAMARIUM ISOTOPES Sm-149
- internal conversion spectra at 5.2 to 8.0 and 0.3 to 1.4 Mev, 18: 24959 (NP-13910)
- neutron capture by, gamma spectra from, 18: 24959 (NP-13910)
- proton elastic scattering at 55 Mev, effects of nuclear deformation on, 18: 24665

SAMARIUM ISOTOPES Sm-150
- gamma transitions, 18: 24959 (NP-13910)

SAMARIUM ISOTOPES Sm-152
- oxygen-16 reactions at 18 to 42 Mev, level excitation in, 18: 24727

oxygen-16 scattering at 38 to 48 Mev, level excitation in, 18: 24729
oxygen-16 scattering at 57 Mev, level excitation in, 18: 24730

SAMARIUM ISOTOPES Sm-153
production in neon-22 and oxygen-18 reactions with thorium-232, 18: 24690

SAMARIUM ISOTOPES Sm-156
production in neon-22 and oxygen-18 reactions with thorium-232, 18: 24690

SAMARIUM OXALATES
dynamic decomposition of, effects of air, carbon dioxide, and nitrogen on, 18: 23507

SAMARIUM OXIDES
spectra in low frequency region, infrared, 18: 23549
CeO_2–Sm_2O_3, equilibrium phase studies on, 18: 23509

SAMARIUM SULFATES
dissociation in water, constants and spectra of, 18: 23501

SANDS
sorptive properties for waste solutions, 18: 24980(T,R) (EURAEC-300)

SAP (SINTERED ALUMINUM PRODUCTS)
creep-rupture properties of M-257, 583, 895, and 915, at 700, 800, and 900°F, 18: 24988(R) (BMI-1665(Del.))
creep-rupture testing of, 18: 24910(R) (SRO-101)
fabrication of APM by extrusion for organic reactors, 18: 24893(R) (NAA-SR-8888(Sect.III))
joining of APM, for organic reactors, 18: 24893(R) (NAA-SR-8888(Sect.III))

SAPPHIRES
crystal structure, 18: 24065(R) (GEMP-34A)

SARCOMAS
metastatic rate of injected epitheliomas in irradiated rats, 18: 23264
radioinduced in mice, beta and x, 18: 23231(R) (ANL-6823(p.20-43))

SATELLITES
cosmic-ray experiments of Cosmos 3 and 5, 18: 24327
cosmic-ray studies of Cosmos 3 and 5, 18: 24328
devices on, for on-board development of exposed nuclear emulsions, 18: 23957
instrumentation for cosmic-ray studies, 18: 23988

SAVANNAH RIVER COMPONENTS TEST REACTOR
development and operations of, summary, 18: 24882(R) (DP-905)
operation of, Apr. 1964, 18: 24910(R) (SRO-101)

SCALERS
applications of fast circuitry in nuclear physics, 18: 24014
design, 18: 23895
design of 10-nsec resolution-time pre-, 18: 24030
micrologic elements for, 18: 23850

SCANDIUM
magnetic properties of, effects of crystalline field and structure on, 18: 24186
neutron capture gamma spectra, 18: 24625 (WASH-1046)
thermal conductivity at 5 to 320°C, 18: 24182

SCANDIUM ALLOYS
Co–Sc, crystal structure of, 18: 24157
Cu–Sc, crystal structure of, 18: 24157
Mn–Sc, crystal structure of, 18: 24157

SCANDIUM FLUORIDES
spectra of, rotational analysis of, 18: 23531

SCANDIUM ISOTOPES
energy levels, 18: 24625 (WASH-1046)

SCANDIUM ISOTOPES Sc-45
nitrogen reactions (N-14,N-15) at 27.5 Mev, excitation functions for, 18: 24716

SCANDIUM MANGANATES
magnetic properties and manganese ion moment configurations of, 18: 24128 (CONF-405-34)
magnetic structures, 18: 23523

SCANDIUM OXIDES
spectra in low frequency region, infrared, 18: 23549
MgO–Sc_2O_3, phase studies on, 18: 23529

SCATTERING
amplitude for inelastic atomic electron, 18: 24307
amplitude singularities for elastic, 18: 24395 (NP-13872)
amplitudes for multichannel, with unstable particles, 18: 24433
amplitudes for, structure of physical sheet and discontinuities across unitary cuts for two- and three particle production, 18: 24455
amplitudes in, analytic continuation of, 18: 24440
amplitudes in, resonance poles in multichannel, 18: 24432
amplitudes of, dispersion relations in, 18: 24383 (JINR-E-1646)
book: *Quantum Scattering Theory. Selected Papers*, a collection of reprints, 18: 24512
collision probabilities in cuboids and cylinders, 18: 24377 (AEEW-M-442)
collision probabilities in, solution of multigroup equations in, 18: 24378 (AEEW-R-326)
Coulomb, nonrelativistic limit of, 18: 24500
cross sections for particles and antiparticles, 18: 24382 (JINR-E-1623)
dispersion relations for, one-variable, 18: 24427
distorted-wave Born approximation expansions in, perturbation technique with convergence for, 18: 24502
effects of anisotropic, in Boltzmann transport equation, 18: 24565 (LA-3051)
phase shift and angle of deflection in, numerical formulae for, 18: 24468
polarization in elastic, strong-absorption model for, 18: 24636
Regge trajectories for Coulomb potential, 18: 24430
symmetry group (SU3) in, generators of, 18: 24422
theory of, comparison of field and s-matrix, 18: 24483 (SUI-63-21)
theory of, gauge invariance in S-matrix, 18: 24497

SCIENCE
index to conferences on nuclear, 1957 through 1963, 18: 25005 (TID-4043(Rev.1))

SCINTILLATION DETECTORS
design for high energy electrons, 18: 23895
development of dE/dx plastic, for pulsed accelerators, 18: 23993
efficiency for assaying iodine-125, 18: 23390
performance for particle detection, comparison with photographic emulsions, 18: 23906
performance in Russian Cosmos 3 and 5 satellites, 18: 24327
performance of air-filled, for alpha particles, 18: 23972
pulse-shape determination by sampling individual photons, nanosecond, 18: 23978
pulse-shape discriminator for, for rejection of gamma events in fast neutron spectroscopy, transistorized, 18: 23994
resolving time of thallium-activated sodium iodide, nanosecond, 18: 23979
sample changer for gamma-well, automatic, 18: 23873 (HW-80798)
temperature effect compensation in, 18: 23964
use for determining human calcium-47 uptake, 18: 23226

SEA URCHINS
radiation effects on sperm of, 18: 23339

SEA WATER
desalination of, feasibility study of dual-purpose power reactor for Florida Keys for, 18: 24906 (NYO-10719)

SEALS AND GLANDS
design for water-cooled and -moderated maritime reactors, 18: 24946(P)
design of O-ring, for high-pressure applications, 18: 25015 (UCRL-7359)
design of welded-metal-bellows, 18: 24823 (TID-7690(p.176-88))
development for gas cooled reactors, 18: 23743 (TID-7690(p.121-42))
friction in, dry, 18: 23742 (TID-7690(p.106-20))
radiation effects on elastomer, gamma and neutron, 18: 24937 (APEX-917)
testing for organic coolant pumps, 18: 24893(R) (NAA-SR-8888(Sect.III))

SEED
analysis for calcium and magnesium, activation, 18: 23418
effects of exposure to low-dose x radiation or soaking in distilled water on growth and development of plants from, 18: 23253(T) (OTS-61-11326)
radiation effects on cytology in bean, gamma, 18: 23252(T) (ORNL-tr-84)
radiosensitivity of tree, 18: 23312

SEEDLINGS
radiation effects on barley, protective effects of chlorides of barium, beryllium, and strontium against, 18: 23368

SEISMOLOGY
conference on high-frequency seismic energy, Lakewood, Colorado, October 15 and 16, 1962, 18: 23784 (NP-13956)

SELENIUM
separation from irradiated strontium oxide targets by partition chromatog-

raphy on teflon, 18: 23731

SELENIUM ISOTOPES Se-73

gamma spectra, 18: 24585(R) (IDO-16969)

SELENIUM ISOTOPES Se-75

use in radiodiagnosis of pancreatic diseases, 18: 23392

SELENIUM SYSTEMS

Er–Se, crystal chemistry and phase studies of, 18: 23506

SEMICONDUCTOR DETECTORS

amplifier design for helium-3 and lithium-6 sandwich-type, for reactor environment, 18: 24024

amplifier for, description of transistorized low-noise, 18: 23997

book: *Semiconductor Counters for Nuclear Radiations*, 18: 23969

design and performance of silicon, for spectrometry of charged particles, 18: 23962

design and performance of counter telescope for 14-Mev neutrons, 18: 23985

development of E and dE/dx, 18: 23984

discriminator circuits for, using tunnel diodes, 18: 24031

neutron reactions with silicon in, 18: 24599 (NP-13930(p.26-38))

neutron reactions with silicon at 5 to 9 Mev in, 18: 24600 (NP-13930 (p.39-40))

operational modes of gold-silicon surface-barrier rectifiers, 18: 23991

performance, 18: 23981

performance as gamma and x-ray dosimeter, 18: 23967

performance for fast-neutron spectroscopy, 18: 23960

performance for particle detection, comparison with photographic emulsions, 18: 23906

preparation and performance of 11-micron dE/dx surface barrier, 18: 23987

preparation by deep lithium-ion-drifting, 18: 23982

pulse amplifiers for, time resolution of nanosecond, 18: 24028

pulse rise-time for gold-silicon surface-barrier, 18: 23983

pulse time and amplitude measuring system for, 18: 23995

pulse time-to-amplitude converter circuit for, 18: 24017

time resolution of silicon-junction, 18: 24023

use in beta and gamma spectroscopy, 18: 23989

use in beta spectroscopy, 18: 23990

use in measuring lifetimes of ultra-shortlived nuclear isomers, 18: 24025

uses, 18: 23902

uses for neutron spectrometry, 18: 23884 (NP-13930(p.159-77))

SEMICONDUCTORS

chemisorption of gases by, 18: 25033(T) (SC-T-64-901)

electric current lifetimes in, measurement of, 18: 23756

electric properties of heat-treated polyacrylonitrile, 18: 24149(T,R) (AEC-tr-6316(p.226-31))

radiation damage in, electron, 18: 24996(R) (NAA-SR-8888(Sect.VI))

SEPARATION PROCESSES

development, 18: 23701(R) (NAA-SR-8888(Sect.V))

SERINE

photolysis of, transformation of amino acids in uv, 18: 23204(T) (JPRS-24164(p.19-42))

synthesis and transformation in uv photolysis of organic compounds in mixtures with ammonium compounds, 18: 23204(T) (JPRS-24164 (p.19-42))

SEWAGE

dilution and flow of, tracer studies on, 18: 24043 (INS-R-14)

SHAPED CHARGES

use in reactor poisoning, 18: 24876 (APEX-142)

SHEEP

radiation effects on testes of, x, 18: 23338

radiation effects on reproductive potential in, x, 18: 23342

SHELTERS

evaluation of protection afforded by wood-frame houses and civil defense, 18: 23826 (NP-13942)

SHERWOOD PROJECT

cryogenics developments in, 18: 24544(R) (NBS-8253)

status, 18: 24755 (NP-13895)

SHIELDED CONTAINERS

design and hazards analysis for shipping cerium-144 and associated impurities from Purex waste, 18: 23823 (HW-65268)

design of transport cask using liquid metal coolant, 18: 23759(P)

fire damage studies for, modeling requirements for, 18: 23827 (NYO-2539-1)

SHIPPING

container fire damage studies, modeling requirements for, 18: 23827 (NYO-2539-1)

of fission products, design of cask for, 18: 23823 (HW-65268)

SHIPPINGPORT PRESSURIZED WATER REACTOR

container integrity testing of butterfly valve hydraulic system test, 18: 24880 (DLCS-3570501)

cooling system testing, Cooldown System performance in, 18: 24881 (DLCS-4140301)

temperature detectors for, calibration of, 18: 24918 (WAPD-PWR-TE-159(Rev.))

SHOCK TUBES

design for plasma production, 18: 24743 (ANL-6802(p.29-36))

SHOCK WAVES

gas temperatures behind, 18: 24236

propagation from underground nuclear explosions, 18: 23783 (NP-13943(p.209-14))

propagation through gases, 18: 24235

structure of slow, in two-fluid system with dissipation, 18: 24226

thermodynamics of, in gases, 18: 24303

SILICIDES

book: *High-Temperature Materials.* No. 1, *Materials Index*, 18: 24075

protective effects on B-66 and D-43 niobium alloys, 18: 24068(R) (NP-13955)

SILICON

abundance variations in A, Ap, and B stars, 18: 24274

determination in highly radioactive fallout particles, x-ray microscopic, 18: 23794

effects on beryllium crystals, 18: 24066(R) (NMI-2126)

effects on mechanical properties of beryllium crystals, 18: 24134(R) (NMI-1257)

effects on oxidation resistance of graphite, 18: 24087 (WADD-TR-61-72(Vol.XXX))

effects on phase transformations in steel, 18: 24152(T,R) (EURAEC-1001)

fabrication and testing as p-type semiconductor detectors, 18: 23984

neutron reactions with, in semiconductor detectors, 18: 24599 (NP-13930 (p.26-38))

neutron reactions at 5 to 9 Mev, semiconductor detector studies of cross sections for, 18: 24600 (NP-13930(p.39-40))

performance as surface-barrier detector, pulse rise-time for, 18: 23983

photon absorption constants for, 18: 24356 (ANL-6802(p.64-5))

preparation and performance of lithium-drifted surface-barrier detectors of, 18: 23982

properties as particle detectors, time-response, 18: 24023

SILICON ISOTOPES Si-28

alpha reactions (α,p) at 18.35 Mev, differential cross sections for, 18: 24687

alpha scattering at 6 to 19 Mev, analysis of, 18: 24712

deuteron reactions (d,n) with, angular distributions and cross sections for, 18: 24611 (NP-13930(p.132-3))

electron inelastic scattering at 40 to 70 Mev, M1 transitions following, 18: 24675

energy levels, 18: 24625 (WASH-1046)

SILICON ISOTOPES Si-30

proton reactions (p,γ) at 2 Mev, polarization in gamma spectra from, 18: 24662

SILICON ISOTOPES Si-31

neutron activation of, dose measurement by, 18: 23890 (SCPRI(S)-92)

SILICON JUNCTIONS

performance of lithium-drifted p-i-n, for gamma and x rays, 18: 23967

radiation effects on diode, gamma and neutron, 18: 24937 (APEX-917)

uses, 18: 23902

SILICON OXIDES

catalytic effects on radioinduced isomerization of 2-butene, 18: 23667

determination in VBWR coolant, 18: 24886(R) (GEAP-4565)

determination in VBWR coolant, 18: 24884(R) (GEAP-4419)

effects on radiation behavior of polymers, 18: 24199(T,R) (AEC-tr-6316 (p.359-67))

sorptive properties for organic compounds, 18: 25032(T) (SC-T-64-618)

spectra in low frequency region, infrared, 18: 23549

PuO_2–SiO_2, preparation and properties of pellets of, 18: 24815(R)

(MLM-1184)
SILICON SYSTEMS
Al–Si–U, fabrication by casting and splat cooling, 18: 24066(R) (NMI-2126)
Al–Si–U, fabrication and properties of hot-pressed and splat-cooled, 18: 24067(R) (NMI-2127)
Al–Si–U, hardness of splat-cooled, at 600°C, 18: 24066(R) (NMI-2126)
Cr–Si–Ti, protective effects on B-66 and D-43 niobium alloys, 18: 24068(R) (NP-13955)
Mo–Si–U, fission effects on, reduction of swelling in, 18: 24996(R) (NAA-SR-8888(Sect.VI))
Nb–Si, electric and mechanical properties, 18: 24158
O–Si–Ti–W–Zr, development for high-temperature oxidation protection of tungsten, 18: 24086(R) (NP-13898)
O–Si–W, development for high-temperature oxidation protection of tungsten, 18: 24086(R) (NP-13898)
SILICONE RUBBERS
radiation effects on, gamma and neutron, 18: 24937 (APEX-917)
SILK
deuterium-hydrogen exchange of fibroin between heavy and light water and, 18: 23470
SILVER
additive effects on radiation resistance of potassium-aluminoborate glass, 18: 24813(R) (ANL-6880(p.49-67))
determination in aqueous solutions by isotope exchange reaction, 18: 23430
determination in small solid samples by mass spectroscopy, design of ion source for, 18: 23406 (CONF-512-4)
efficiency drift of foil of, in secondary electron monitor for linear accelerator at 15 Mev, 18: 24253
electron and positron disintegration, 18: 24625 (WASH-1046)
electron bombardment of films of, products from, 18: 24319
gamma reactions (γ,γ') with, method for measuring cross sections, 18: 24637
growth of films of, sputtering, 18: 24074
neon-20 reactions at 200 Mev, mechanisms of, 18: 24732
neutron capture by, use of lead spectrometer for studying, 18: 24608 (NP-13930(p.110-11))
photofission at 300 to 1000 Mev, cross sections for, 18: 24655
sorption of americium-241 and protactinium-233 by, from water–ethanol solutions, 18: 23724
superconductivity, 18: 24179
SILVER ALLOYS
superconductivity of metastable intermetallic compounds in, 18: 24142 (TID-20617)
superconductivity, 18: 24179
Mg–Ag, performance as dynodes, effects of cesium on, 18: 23865
SILVER BROMIDES
charged particle reactions with electrons in, in emulsion, 18: 23908
reactions with triethanolamine in emulsions, 18: 23552
SILVER ISOTOPES Ag-105
gamma spectra, 18: 24585(R) (IDO-16969)
SILVER ISOTOPES Ag-106
gamma spectra, 18: 24585(R) (IDO-16969)
SILVER ISOTOPES Ag-109
neutron reactions (n,γ) with, gamma energy measurements at 660 kev in, 18: 24637
SILVER ISOTOPES Ag-110
decay of isomeric, internal conversion spectrum from, 18: 24738
gamma-gamma coincidence spectra of, 18: 24637
SILVER NITRATES
effects on gamma-induced polymerization of acrylonitrile in dimethylformamide, 18: 23595(T,R) (AEC-tr-6316(p.145-51))
radiolysis of, alpha, gamma, and optical, 18: 23687
use as thermal neutron monitor, 18: 23896
acetonitrile–$AgNO_3$, electric conductivity and viscosity of, 18: 25000 (RPI-1999-3)
benzonitrile–$AgNO_3$, electric conductivity and viscosity of, 18: 25000 (RPI-1999-3)
SILVER OXIDES
spectra in low frequency region, infrared, 18: 23549
SINGLE CRYSTALS
diffusion in, measurement of volume, 18: 23522
SKELETON
strontium-90 content in human, calculation of, 18: 23224
SKIN
infection of, in irradiated rabbits, effectiveness of antibiotic therapy, 18: 23315
iodine-131 content in, of man and rats, 18: 23207(T) (JPRS-24704 (p.6-11))
radiation injuries of rabbit, protective effects of esculin against, 18: 23372
SODIUM
analysis of liquid, for impurities, development of methods for, 18: 23411(R) (TID-20614)
compatibility with plutonium nitrides, 18: 24988(R) (BMI-1665(Del.))
electron elastic scattering cross sections at low energies, 18: 24298 (N64-13373)
fission-product retention by, 18: 24816(R) (NAA-SR-8888(Sect.IV))
heat transfer in two-phase, 18: 24891(R) (NAA-SR-8888(Sect.I))
neutron scattering in, energy transfer in, 18: 24625 (WASH-1046)
neutron total cross sections at 8.58 to 11.59 Mev, 18: 24591(R) (LMSC-4-50-62-1)
reactions with graphite, 18: 24907 (ORNL-TM-870)
reactions with water in Sodium Reactor Experiment pipe gallery, hazards analysis of, 18: 24894 (NAA-SR-Memo-7743)
reactivity coefficients of voids in, in reactors, 18: 24813(R) (ANL-6880(p.49-67))
sorption by calcium and potassium zeolites, selectivity coefficients for, 18: 23480
sorption by phosphoric acid resins, effects of acidity on selectivity coefficients for, 18: 23481
SODIUM ACID CARBONATES
solvent properties of solutions of, for radium and uranium, 18: 23711
SODIUM AZIDES
effects on action-potentials of x-irradiated nerve fibers, 18: 23277
protective effects against radiation damage to plant cells, 18: 23374
SODIUM CARBONATES
solvent properties for highly radioactive fallout particles, 18: 23795
SODIUM CHLORATES
sodium-23 NMR in, quadrupole splitting of, 18: 23464
SODIUM CHLORIDES
proton relaxation times in aqueous solutions of, 18: 23559
KCl–NaCl, corrosive effects on metals at 700, 800, and 900°C, 18: 24089
LiCl–$MgCl_2$–NaCl, phase studies on, 18: 24813(R) (ANL-6880 (p.49-67))
$MgCl_2$–KCl–NaCl, solvent properties for praseodymium, 18: 24952(R) (ANL-6880(p.6-48))
SODIUM FIRES
fission product release during in-reactor, 18: 24891(R) (NAA-SR-8888(Sect.I))
SODIUM FLUORIDE COMPLEXES
with rare earth fluorides, phase studies, 18: 23441 (CONF-405-40)
SODIUM FLUORIDES
proton relaxation times in aqueous solutions of, 18: 23559
SODIUM GRAPHITE REACTORS
development of components and fuels for, 18: 24891(R) (NAA-SR-8888(Sect.I))
SODIUM HYDROXIDES
analytical use in titration of aqueous boric acid, 18: 23412 (UCRL-7756)
radiolysis of, hydrated electron absorption spectrum and reaction constants for, 18: 23691
SODIUM IODIDES
scintillation resolving time of thallium-activated, 18: 23979
SODIUM ISOTOPES Na-22
mobility of ionic, in aqueous solutions of potassium nitrate at 25°C, 18: 23467
SODIUM ISOTOPES Na-23
neutron scattering at 0 to 4 Mev, nuclear model calculations of, 18: 24597 (NP-13930(p.15))
nitrogen reactions $(N\text{-}14,\alpha)$ at 27 Mev, angular momentum effects in, 18: 24726
nuclear magnetic resonance in sodium chlorates, quadrupole splitting of,

18: 23464

SODIUM ISOTOPES Na-24

mobility of ionic, in aqueous solutions of potassium nitrate at 25°C, 18: 23467

production in aluminum-27 (n,α) reactions, 18: 24592 (NP-13913)

SODIUM NIOBATES

$NaNbO_3$–$NaTaO_3$, phase studies, 18: 24162

SODIUM NITRATES

protective effects of, against radiation injuries in mice, 18: 23356(R) (NP-13918(p.99-106))

SODIUM NITRITES

nitrogen-15 NMR in, chemical shifts in, 18: 23530

SODIUM REACTOR EXPERIMENT

fuel processing for Core II, 18: 24891(R) (NAA-SR-8888(Sect.I))

hazards analysis of sodium-water reaction in pipe gallery, 18: 24894 (NAA-SR-Memo-7743)

operation during 1963, 18: 24891(R) (NAA-SR-8888(Sect.I))

SODIUM SALICYLATES

radiation effects on luminosity of aqueous solutions, 18: 23580 (PAN-488/XVII)

SODIUM SULFATES

solvent properties for highly radioactive fallout particles, 18: 23795

SODIUM SULFITES

protective effects on amidol photographic developer, 18: 23554

SODIUM TANTALATES

$NaNbO_3$–$NaTaO_3$, phase studies, 18: 24162

SODIUM URANYL PHOSPHATES

solubility of, tracer studies of, 18: 23545

SOILS

analysis for antimony-125 from fallout, radiochemical, 18: 23431

analysis for tritiated water, liquid scintillation counting method for, 18: 23419

bibliography on tracer methods for moisture measurements in, 18: 24044 (NP-13931)

blast effects of underground nuclear explosions on, 18: 23783 (NP-13943(p.209-14))

deformation by cylindrical projectiles, 18: 25001(R) (SC-DC-64-459)

inspection for buried objects, using x-ray backscatter, 18: 23782 (NP-13943(p.117-27))

plant relations to, in arid regions, 18: 23168(R) (STI/DOC/10/25(p.99-111))

radiation effects on, electron and gamma, 18: 23171

radiation effects on, for subsequent plant growth, 18: 23318

rubidium-86 uptake by, factors affecting, 18: 23227

sorptive properties for waste solutions, 18: 24980(T,R) (EURAEC-300)

water uptake by, tracer technique for measuring, 18: 24045

SOLAR BATTERIES

development, 18: 24356 (ANL-6802(p.64-5))

development of photovoltaic and thermoelectric, 18: 24353 (ANL-6802(p.24-5))

development of Sunflower, 18: 24085(R) (NASA-CR-54053)

development of thermoelectric, for space uses, 18: 24351(R) (AD-427285)

SOLAR FLARES

area of, center-limb effect of, 18: 24272 (NP-13804)

detection of, radio method for, 18: 24284

effects in E and D ionosphere layers, 18: 24283

geotectonic effects from, indirect, 18: 24528

properties of, spectrophotometric studies of, 18: 24269 (NP-13801)

spectra, 18: 24271 (NP-13803)

statistics, 18: 24270 (NP-13802)

SOLAR RADIATION

analysis for neutrinos, problems in, 18: 24295

diffusion of, radial magnetic field in, 18: 24330

effects of corpuscular, on outer atmosphere, 18: 24526

effects of corpuscular streams on SC geomagnetic storms, 18: 24518

effects on auroras, 18: 24524

effects on geomagnetic activity, 18: 24531

intensity of, cosmic-ray secular variation with, 18: 24331

interactions with atmospheres of comets, 18: 24282

interplanetary dust grain perturbation by, 18: 24279

nuclear composition and rigidity spectra, 18: 24326

properties of, determination by cosmic ray intensity variations due to changes in interplanetary electromagnetic states, 18: 24345

SOLIDS

atom migration and pore motion in, thermodynamics of, 18: 24069 (NP-13957)

neutron diffusion in, lattice structure effects in, 18: 24577

reactions with gases, role of chemisorption in, 18: 25033(T) (SC-T-64-901)

SOLUTIONS

composition of scintillation, for measuring tritiated water in soils, 18: 23419

concentration of dilute aqueous heat-labile, design of vacuum distillation system for, 18: 23445 (K-1594)

SOLVENT EXTRACTION PROCESSES

use in separation of lanthanides and trivalent actinides, 18: 23699 (CONF-405-37)

SOLVENTS

properties of organic, for metal ions in ion exchange separation process, 18: 23707(R) (TID-20609)

purification for plutonium extraction process by fission product removal i water vapor carry-over, 18: 23698 (CEA-R-2404)

SORBOSE

radioinduced free radicals in, gamma, 18: 23651(T,R) (AEC-tr-6316 (p.573-86))

SOUND

excitation of zero, in nuclear matter, 18: 24693

reflection from statistically rough surface, 18: 24516(T) (JPRS-24633)

SPACE

electromagnetic states of interplanetary, effects of solar winds on, 18: 24345

electromagnetic state changes in interplanetary, cosmic ray intensity variations from, 18: 24345

interplanetary dust grain perturbation in, 18: 24279

plasma in, observations on, 18: 24749 (CONF-521-2)

SPACE POWER UNIT REACTOR

testing, 18: 24945

SPACE VEHICLES

power plants for, distribution and generation subsystems in, 18: 2494

power plants for, development of nuclear- and solar-thermoelectric, 18: 24351(R) (AD-427285)

power plants for, development of thermionic, 18: 24370(R) (PWA-2337)

propellant feed systems for ion engines in, 18: 23754 (NASA-CR-51)

propulsion of, development of ion engines for, 18: 23740(R) (NP-1389

propulsion of, energy conversion problems in electric, 18: 24358 (ANL-6802(p.89-99))

radiation detectors on, performance of nuclear-emulsion, 18: 23955

radiation detectors for, development methods for nuclear-emulsion, 18: 23956

radiator design for nuclear-electric, 18: 23779

radiator materials for, 18: 24138(R) (PWA-2206(Vol.I))

radiator materials for, 18: 24139(R) (PWA-2206(Vol.II))

radiator materials for, 18: 24140(R) (PWA-2206(Vol.III))

re-entry burnup studies of reactor fuel elements, 18: 24933 (AFSWC-TDR-63-51)

shielding design for, optimization theory for proton, 18: 24805 (UNC-5049)

shielding for, analysis of electrostatic, 18: 24807

SPARK DETECTORS

data analysis system for, flying-spot digitizer on-line with IBM 7090 for automatic, 18: 23998

data analysis, computer program for, 18: 23872 (BNL-833)

data processing for scattering experiment in sonic, 18: 24000

development for relativistic charged particles, 18: 23874 (JINR-P-1619)

development of self-triggering medical, 18: 23976

memory cell period in, 18: 24473

operation of, mechanisms for, 18: 23968

particle ionization ability measurements in, 18: 24473

particle tracks in lead-plate, analysis of, 18: 23973

performance for particle detection, comparison with photographic emulsions, 18: 23906

pulse generator for relativistic, 18: 23843

review, 18: 23971

triggering of sonic, solid-state units for, 18: 23999

SPECTRA

magnetic field effects on Doppler shift of stellar, 18: 24289

SPECTROMETERS

design and performance of silicon semiconductor for charged particles, 18: 23962

design of sum-coincidence, 18: 24604 (NP-13930(p.54-5))

development, 18: 24625 (WASH-1046)

testing optical, 18: 24300(R) (NP-13953)

SPECTROPHOTOMETRY

use in solar flare observations, 18: 24269 (NP-13801)

SPECTROSCOPY

nuclear magnetic resonance, review on long-range H^1–H^1 spin-spin coupling in, 18: 24234

SPERM

radiation effects on metabolism in bull, gamma, 18: 23297

radiation effects on metabolism of, gamma, 18: 23334

radiation effects on sea urchin, 18: 23339

temperature effects on brood pattern of x-irradiated Drosophila, 18: 23279

SPERMATOGENESIS

effects of estrogenic hormones on rat, comparison of, with radiation effects, 18: 23332

radiation effects on, x, 18: 23324

radiation effects on rat, comparison of electron, with effects of estrogenic hormones, 18: 23332

radiosensitivity of various stages in rat, 18: 23331

rate in man, tracer study of, 18: 23176

SPHERES

radiation field diffraction on, 18: 24516(T) (JPRS-24633)

SPLEEN

plutonium-239 removal from mouse, using calcium salt and pentaethyl ester of carboxymethyliminobis(ethylenenitrilo)tetraacetic acid, 18: 23369

primary immune response of germinal centers of, in mice, 18: 24998 (ORNL-3595)

radiation effects on histology and saline-soluble DNA content in mouse, 18: 23257

radiation effects on mercamine metabolism in, 18: 23304

SPORES

radiation effects on *Rhizopus stolonifer*, protective effects of germination inhibition against, 18: 23288

radiation effects on *Rhizopus stolonifer*, protective effects of oxygen against, 18: 23288

SPUTTERING

use in epitaxial growth of gold and silver films, 18: 24074

STAINLESS STEEL

carburization of types 304 and 316, in sodium saturated with carbon at 1200°F, 18: 24084(R) (MSAR-64-51)

coating of type 316, with Solaramic 5210-2c glass, 18: 24085(R) (NASA-CR-54053)

contamination and decontamination in uranium–zirconium processing equipment, 18: 23705 (ORNL-TM-837)

corrosion by water, oxide film tenacity and release of retained film radioactivity in, 18: 24082 (HW-79811)

corrosion in PM-1 Reactor control rod drive system pressure thimble, 18: 24890 (MND-M-3088 & Add.1)

corrosion of type 316, by lithium, lithium halide–lithium hydride systems, and lithium hydrides at 1000 to 1650°F, 18: 24085(R) (NASA-CR-54053)

corrosion of type 347, by lithium hydrides at 1165 to 1600°F, 18: 24085(R) (NASA-CR-54053)

corrosion of 304 and 347, by stresses and aqueous solutions, 18: 24125(R) (CEND-3256-209)

crystal structure and mechanical properties of, prepared from high-purity metals, 18: 24151(T) (EURAEC-986)

emissivity of coated 310, in vacuum, 18: 24138(R) (PWA-2206(Vol.I))

emissivity of coated 310, in vacuum, 18: 24139(R) (PWA-2206(Vol.II))

emissivity of coated 310, in vacuum, 18: 24140(R) (PWA-2206(Vol.III))

heat transfer from, by nucleate boiling, 18: 23761 (AEEW-R-180)

mechanical properties of 347, for reactor fuel tubes, 18: 24854(R) (CEND-2863-211)

performance of 304, as fuel cladding in fast reactors, 18: 24952(R) (ANL-6880(p.6-48))

performance of 304, 310, and 406, in nuclear-superheater environment, 18: 24886(R) (GEAP-4565)

performance of 304, 316, 347, and 406, in nuclear superheater environment, 18: 24884(R) (GEAP-4419)

radiation effects on mechanical properties of austenitic, 18: 24192 (HW-SA-3221)

strain testing of type-304, for sodium-cooled reactors, 18: 24891(R) (NAA-SR-8888(Sect.I))

tensile properties at 20 and 400°C of irradiated pressure tubes of type 347, after postirradiation annealing, 18: 24988(R) (BMI-1665(Del.))

welding of, Hanford guide to procedures and specifications for, 18: 24103 (TID-20625(Vol.II))

welding of, Hanford guide to procedures, specifications, and qualification test records for, 18: 24104 (TID-20625(Vol.III))

welding of, to assemble or seal plutonium-containing fuel elements, 18: 24100 (HW-SA-3146)

stainless steel–ZrC, compatibility with uranium carbide–zirconium carbide, 18: 24072(T,R) (EURAEC-934)

STARCHES

radioinduced free radicals in, gamma, 18: 23651(T,R) (AEC-tr-6316 (p.573-86))

sorptive properties for organic compounds, 18: 25032(T) (SC-T-64-618)

STARS

collapse of, energy-momentum tensor for, 18: 24291

evolution of, neutrino density in, 18: 24273

magnesium and silicon abundance variations in A, Ap, and B, 18: 24274

spectra of, magnetic field effects on Doppler shift of, 18: 24289

STATISTICS

Boltzmann's equation, derivation of, 18: 24507

economics of plutonium, thorium, and uranium fueled reactors, 18: 24858(R) (HW-80560F)

higher-order spacing distributions for a class of unitary ensembles, 18: 24679

of nuclear level intervals and widths, 18: 24598 (NP-13930(p.17-25))

of solar flares, 18: 24270 (NP-13802)

uses for controlling scanning efficiency in nuclear emulsion, 18: 23944

STEAM

analysis of superheated, for gases, design of gas chromatograph for, 18: 23407 (DP-880)

effects on separation of iodine vapor from air streams by adsorption on charcoal, 18: 23386 (CONF-12-3)

reactions with aluminum–uranium alloys at 1200 to 1600°C, 18: 23817(R) (ANL-6880(p.72-8))

steam-water, heat transfer in flows through pipes, 18: 24910(R) (SRO-101)

STEEL

ductility of, effects on hydrogen on, 18: 24153(T,R) (EURAEC-1002)

phase transformations in low-alloy, effects of additives on, 18: 24152(T,R) (EURAEC-1001)

phase transformations in, analysis of martensitic, 18: 24994(R) (MND-2531-1)

polishing by electrolytic methods, 18: 24107(T) (SC-T-64-903)

radiation effects on stressed tubes of A302B, neutron, 18: 24190(R) (GA-5037)

stress analysis of mild, 18: 24824(R) (TID-20613)

stress fatigue in pressure vessels, method of predicting, 18: 24130 (D2-22437)

stress-corrosion of mild, effects of aging, aluminum content, and heat treatment on, 18: 24088(T) (AEC-tr-6394)

tin coating thicknesses on, measurement by gamma excitation of x-ray fluorescence, 18: 24046 (PAN-485/I-A)

STERILITY

effects of radiomimetic agents on mouse, 18: 23177

radiation effects on cotton moth, 18: 23283

radiation effects on mouse, gamma, 18: 23326

radioinduced in insects, effects of air and carbon dioxide on, gamma, 18: 23276

radioinduced in mice, x, 18: 23325

STEROIDS

effects on enzyme activity in liver of irradiated rats, 18: 23241(R) (NP-13918(p.13-27))

effects on excretion of taurine and sulfate by rats, 18: 25006 (TID-18927)
effects on radiosensitivity of enzyme systems in rat liver, 18: 23352(R) (NP-13918(p.28-41))
STRAIN GAGES
error analysis of two-component balance in, 18: 25002 (SC-TM-64-8)
STRANGE PARTICLES
bibliography on, 18: 24214 (AED-C-23-01)
STRATOSPHERE
cosmic radiation in, secular variation of, 18: 24331
fallout transport mechanisms in, 18: 23799
STREPTOMYCIN
protective effects against radiation injury to chromosomes of reproductive cells in mice, 18: 23359(T) (JPRS-24593(p.120-5))
STRESS CORROSION
analysis in 304 and 347 stainless steels, 18: 24125(R) (CEND-3256-209)
STRONTIUM
content in deep crustal material, 18: 23801
effects on strontium-90 uptake by oats, 18: 23206(T) (JPRS-24290 (p.43-7))
precipitation as complex with cesium, lead, or rubidium chlorides from melt, 18: 23540
separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)
separation from barium by exchange between amalgam and solution, 18: 23734
separation from calcium by continuous electrophoresis, 18: 23721
separation from radioactive waste water by ferric hydroxide flocculation, 18: 24981
separation from yttrium by sorption on gelatin foam, 18: 23735
STRONTIUM CHLORIDES
protective effects of aqueous solutions of, against radiation in barley seedlings, 18: 23368
STRONTIUM ISOTOPES
neutron capture, 18: 24625 (WASH-1046)
STRONTIUM ISOTOPES Sr-85
effects of tetracycline on retention of, in mice and rats, 18: 23220
metabolism in miniature swine, effects of administration as titanate or chloride on, 18: 23200 (HW-SA-3350)
STRONTIUM ISOTOPES Sr-86
content in deep crustal material, 18: 23801
STRONTIUM ISOTOPES Sr-87
content in deep crustal material, 18: 23801
STRONTIUM ISOTOPES Sr-88
neutron reactions (n,2n) at 12.5 to 19.6 Mev, cross sections for, 18: 24602 (NP-13930(p.43-9))
STRONTIUM ISOTOPES Sr-89
content in cow's milk, 18: 23829
content in Swedish food, 1962, 18: 23790 (NP-13828)
separation by calcium phosphate–humic acid flocculation, 18: 24982
STRONTIUM ISOTOPES Sr-90
content in cow's milk, 18: 23829
content in human skeleton, calculation of, 18: 23224
content in marine organisms and sea water of Pacific Ocean in vicinity of Japan, 1959 through 1961, 18: 23792 (WP/37)
content in rats, effects of calcium-rich diet during lactation on, 18: 23216
content in Swedish food, 1962, 18: 23790 (NP-13828)
content of human bones, 1961 to 1963, 18: 23833
determination by Kawabata-Held method, 18: 23408 (NVO-162-8)
determination in bone, radiochemical, 18: 23402 (AERE-R-4466)
determination in drinking and river waters and urine by ion exchange, 18: 23421
dietary effects on mortality, reproduction, and tumor tolerance in mice, 18: 23210
distribution and retention in rat tissues, effects of age, dose, and administration route on, 18: 23243 (UR-642)
distribution in milk products, 18: 23800
metabolism, 18: 23816 (AHSB(S) R-64)
metabolism in miniature swine, effects of administration as titanate or chloride on, 18: 23200 (HW-SA-3350)
pathological effects of injected, in rat embryos, 18: 23244 (UR-643)
radiation dose to mouse gonads from injected, 18: 23185(R) (ANL-6823(p.76-80))
separation from melts by complex formation with cesium, lead, or rubidiu chlorides, 18: 23540
separation from yttrium-90, 18: 23717
sorption by zeolites, 18: 23717
tumorigenic effects in mice, 18: 23231(R) (ANL-6823(p.20-43))
uptake by marine organisms, 18: 23212
uptake by oats, factors affecting, 18: 23206(T) (JPRS-24290(p.43-7))
used with yttrium-90, bremmsstrahlung efficiency in bone of, 18: 23173
STRONTIUM NITRATES
radioinduced spin-½ centers in single-crystal, gamma, 18: 23474
STRONTIUM OXIDES
dissociation energy of, mass spectrometric determination of, 18: 23455 (WADD-TR-60-782(Pt.XXII))
proton reactions at 660 Mev, 18: 23731
separation from selenium by partition chromatography on teflon, 18: 23731
spectra in low frequency region, infrared, 18: 23549
STRONTIUM ZIRCONATES
preparation and properties of, 18: 24094(R) (AD-436324)
STRUCTURES
book: *Structures for Nuclear Power*, 18: 24926
STYRENE POLYMERS
electron reactions at 20 to 86 Mev, ionization energy losses in, 18: 24702
radioinduced free radicals in, effects of pigments on, 18: 24199(T,R) (AEC-tr-6316(p.359-67))
radioinduced luminescence in, efficiency of, 18: 23662
STYRENES
radioinduced graft polymerization on polyvinyl alcohol, effects of solvents on gamma, 18: 23581(T,R) (AEC-tr-6316(p.66-9))
radioinduced graft polymerization on polyvinyl alcohol, effects of environment on, 18: 23582(T,R) (AEC-tr-6316(p.70-5))
radioinduced graft polymerization on polyvinyl alcohol, gamma, 18: 23583(T,R) (AEC-tr-6316(p.76-8))
radioinduced graft polymerization on polyvinyl alcohol fiber, 18: 23584(T,R) (AEC-tr-6316(p.79-83))
radioinduced graft polymerization on cellulose, gamma, 18: 23585(T,R) (AEC-tr-6316(p.84-8))
radioinduced graft polymerization on preirradiated cellulose, 18: 23586(T,R) (AEC-tr-6316(p.89-94))
radioinduced graft polymerization on preirradiated cellulose, effects of atmosphere on, 18: 23587(T,R) (AEC-tr-6316(p.95-9))
radioinduced graft polymerization on polyethylene and polypropene, gamma, 18: 23589(T,R) (AEC-tr-6316(p.105-13))
radioinduced graft polymerization on polyoxymethylene, 18: 23607(T,R) (AEC-tr-6316(p.223-5))
radioinduced graft polymerization on viscose cellulose, gamma, 18: 23643(T,R) (AEC-tr-6316(p.498-500))
radioinduced graft polymerization on polyethylene terephthalate, gamma, 18: 23657(T,R) (AEC-tr-6316(p.640-9))
radioinduced graft polymerization on cotton and rayon, gamma, 18: 23658(T,R) (AEC-tr-6316(p.650-9))
radioinduced graft polymerization on polypropene, 18: 23624(T,R) (AEC-tr-6316(p.368-80))
radioinduced polymerization with methyl methacrylate on alumina base, gamma, 18: 23594(T,R) (AEC-tr-6316(p.137-44))
radioinduced polymerization with β-propiolactone, 18: 23604(T,R) (AEC-tr-6316(p.190-4))
sulfo-, ion exchange properties of, in neutral and weakly acid range, 18: 23736
SUCCINIC ACID
sulfo-, uses as surface-active agent in preparation of nuclear emulsions, 18: 23495
SUCROSE
protective effects against radiation damage to plant cells, 18: 23374
radioinduced free radicals in, gamma, 18: 23651(T,R) (AEC-tr-6316 (p.573-86))
SUGARS
sorptive properties for organic compounds, 18: 25032(T) (SC-T-64-618)
SULFATE COMPLEXES

- with uranium, stability constants of, 18: 23534

SULFATE IONS
- determination in beryllium solutions by cation exchange, 18: 23423

SULFATES
- determination of sulfur-35 labeled, in labeled phosphates and pyrophosphates by activation, 18: 23417
- excretion by rats, effects of adrenalectomy on, 18: 25006 (TID-18927)

SULFOXIDES
- dioctyl-, solvent properties for uranyl chloride and nitrate, 18: 23716

SULFUR
- neutron total cross section of, 18: 24625 (WASH-1046)

SULFUR CHLORIDES
- reactions with pollucite ores at 550 to 700°C, cesium separation by, 18: 24991 (IS-884)

SULFUR DIOXIDES
- determination in superheated steam, design of gas chromatograph for, 18: 23407 (DP-880)
- effects on radioinduced crosslinking of natural rubber, 18: 23637(T,R) (AEC-tr-6316(p.449-55))
- effects on radioinduced isomerization of 2-butene, 18: 23666
- radioinduced graft polymerization of propene and, on polyethylene, gamma, 18: 23642(T,R) (AEC-tr-6316(p.481-97))
- radioinduced reactions with acrylamide and methacrylamide monomers and polymers, 18: 23650(T,R) (AEC-tr-6316(p.567-72))

SULFUR FLUORIDES
- $Ar–SF_6$, electric conductivity of plasma jet of, 18: 23532

SULFUR ISOTOPES S-32
- neutron capture and transmission at 10 to 80 kev, resonance, 18: 24620(R) (ORNL-TM-874)
- neutron reactions (n,p) with, for neutron flux measurements, 18: 23885 (NP-13930(p.178-80))
- neutron transmission by, resonances in, 18: 24625 (WASH-1046)
- nitrogen reactions (N-14,O-15) at 27.5 Mev, excitation functions for, 18: 24716

SULFUR ISOTOPES S-35
- chemical effects on specific surface of molybdenum disulfide, 18: 23696

SULFURIC ACID
- radiolysis of aqueous solutions of, uv spectra of transients in, 18: 23683
- radiolysis of, hydrated electron absorption spectrum and reaction constants for, 18: 23691
- separation of uranium from, by anion exchange, 18: 23710
- $H_2SO_4–H_2O$, radiolysis by alpha particles, 18: 23675

SUN
- activity on, variation of equatorial spread-F with, 18: 24535
- corona electron temperatures, effect of corona expansion on, 18: 24278
- corona of, electron temperature in, 18: 24281
- rotation of, interior, 18: 24287

SUPERCONDUCTIVITY
- electron behavior in strong spin-exchange fields, 18: 24563
- equipment developments for measuring, 18: 24544(R) (NBS-8253)
- of ferromagnetic metals, 18: 24305
- of metastable intermetallic compounds in gold and silver alloys, 18: 24142 (TID-20617)
- of noble metals and their alloys, 18: 24179
- persistent currents in rotating cylinders, 18: 24549
- theory of, field theoretical method in, 18: 24545
- theory of, pairing correlations at nuclear surface layer in, 18: 24630

SUPERCONDUCTORS
- critical fields of second-kind, lower, 18: 24562
- critical temperature enhancement in titanium alloy, 18: 24553
- electric conductivity anomalies in, effects of s-d exchange interactions in, 18: 24555
- electric conductivity of, electron-phonon interactions in, 18: 24557
- electron behavior in metals containing paramagnetic impurities causing spin-exchange fields, 18: 24563
- ferromagnetism in alloys of, 18: 24561
- lattice stability of Abrikosov vortex lines, energy and elastic moduli calculations of, 18: 24230
- magnetic behavior and I-H curve of anchored-filament-structure, 18: 24552
- performance of resonators of, 18: 24559
- properties of, effects of high pressures on, 18: 24560
- resistive behavior of second-kind, for viscous flux flow, 18: 24550
- surface superconductivity beyond H_{c2} in type II, 18: 24548
- theory of organic, 18: 24554
- use of magnets of, in ESR studies, 18: 23524
- uses of, review, 18: 24546
- vortex line bound fermion states in type-II, low-energy excitation of, 18: 24551
- vortex wave spectrum of type II, 18: 24556

SUPERHEATERS (NUCLEAR)
- design, 18: 24931(P)
- fuel cladding materials evaluation for, 18: 24080 (BMI-X-286)
- fuels and materials testing for, 18: 24886(R) (GEAP-4565)
- fuels and materials testing for, 18: 24884(R) (GEAP-4419)
- operations of Borax-V, summary, 18: 24951(R) (ANL-6880(p.1-5))

SUPERSONIC FLOW
- interface stability between two fluids in, effects of compressibility on, 18: 24999 (RM-3953-AEC)

SURFACE-ACTIVE AGENTS
- effects on properties of nuclear emulsions, 18: 23495

SURFACE WATERS
- analysis for barium-140, radium-226, and strontium-90 by ion exchange, 18: 23421

SWEDEN
- fallout monitoring, 1962, 18: 23790 (NP-13828)

SWIMMING POOL REACTORS
- control and safety systems of Siloe, 18: 24966
- coolant radioactivity and airborne radioactivity in Indian Apsara, 18: 24947 (AEET/AM/38)
- description and operation of ISPRA-2, 18: 24962 (RT/ING(63)-25)
- design of Siloe, 18: 24965
- performance of IRT-2000, 18: 24960 (NP-13911)

SWINE
- metabolism of strontium-85, strontium-90, promethium-147, and cerium-144 in miniature, 18: 23200 (HW-SA-3350)

SYNCHROCYCLOTRONS
- modifications to CERN, 18: 24255

SYNCHROTRONS
- beam injector synchronization for 300-Bev, for r-f systems, 18: 24240 (CERN-64-20)
- detector development for CERN proton, dE/dx plastic scintillation-type, 18: 23993
- electron oscillations in, electrodynamic, 18: 24264
- electron oscillations in, 18: 24265
- particle accelerators at CERN, 18: 24263
- use of Frascati internal beam for (e,e'p) studies, proposed, 18: 24243 (ISS-63/42)

SYSTEMS FOR NUCLEAR AUXILIARY POWER
- power conditioning, distribution, and generation systems in, 18: 24942
- re-entry burnup studies of reactor fuel elements, 18: 24933 (AFSWC-TDR-63-51)

SYSTEMS FOR NUCLEAR AUXILIARY POWER (SNAP-2)
- hazards evaluation in STEP project, 18: 24956(R) (IDO-16961)

SYSTEMS FOR NUCLEAR AUXILIARY POWER (SNAP-10)
- design, 18: 24944
- hazards evaluation in STEP project, 18: 24956(R) (IDO-16961)
- test plan for, re-entry, 18: 24941 (SC-RR-64-501)

SYSTEMS FOR NUCLEAR AUXILIARY POWER (SNAP-50)
- testing, 18: 24945

T

TANTALUM
- coating with tantalum borides and carbides, 18: 23740(R) (NP-13899)
- degradation in thermionic diodes, 18: 24368 (JPL-TR-32-548)
- effects on phase transformations in steel, 18: 24152(T,R) (EURAEC-1001)
- emissivity of coated, in vacuum, 18: 24138(R) (PWA-2206(Vol.I))
- emissivity of coated, in vacuum, 18: 24139(R) (PWA-2206(Vol.II))
- emissivity of coated, in vacuum, 18: 24140(R) (PWA-2206(Vol.III))
- neon-20 reactions at 160 Mev, multinucleon stripping in, 18: 24717
- performance as coatings on tantalum and tungsten, 18: 23740(R) (NP-13899)
- proton elastic scattering at 55 Mev, effects of nuclear deformation on,

- 18: 24665
- thermal capacity and emissivity at 1300 to 1850°K, 18: 24122 (ASD-TDR-63-371)

TANTALUM ALLOYS
- radiation effects on mechanical properties and microstructure of, at 50°C, 18: 24193 (HW-SA-3436)
- Hf–Ta–W, factors affecting vacuum-arc melting of, 18: 24070 (RTD-TDR-63-4089)
- Nb–Ta, electric and mechanical properties, 18: 24158
- Nb–Ta–W–Zr, fabrication and properties of forged and rolled FS-85, 18: 24093(R) (AD-424593)

TANTALUM BORIDES
- performance as coatings on tantalum and tungsten, 18: 23740(R) (NP-13899)
- TaB–TaC, performance as electrodes in ion engines for spacecraft, 18: 23740(R) (NP-13899)
- TaB–TaC, performance as coatings on tantalum and tungsten, 18: 23740(R) (NP-13899)

TANTALUM CARBIDES
- electric properties of, rigid band model for interpreting, 18: 24137 (NP-13944)
- performance as coatings on tantalum and tungsten, 18: 23740(R) (NP-13899)
- TaB–TaC, performance as electrodes in ion engines for spacecraft, 18: 23740(R) (NP-13899)
- TaB–TaC, performance as coatings on tantalum and tungsten, 18: 23740(R) (NP-13899)

TANTALUM CRUCIBLES
- reactions of zirconia-lined, with liquid bismuth, 18: 24815(R) (MLM-1184)

TANTALUM ELECTRODES
- diffusion of keypton in, under glow discharge, 18: 24065(R) (GEMP-34A)
- performance in thermionic cells, 18: 24360 (ANL-6802(p.126-43))

TANTALUM ISOTOPES Ta-181
- deuteron reactions (d,p) with, 18: 24625 (WASH-1046)

TANTALUM ISOTOPES Ta-182
- neutron total cross section and resonance parameters of, below 3.0 ev, 18: 24584 (IDO-16956)

TANTALUM NITRIDES
- electric properties of, rigid band model for interpreting, 18: 24137 (NP-13944)

TANTALUM OXIDES
- spectra in low frequency region, infrared, 18: 23549

TAURINE
- determination in urine using autoanalyzer, 18: 25007 (TID-18929)
- excretion by rats, effects of adrenalectomy on, 18: 25006 (TID-18927)

TECHNETIUM ALLOYS
- Tc–Zn, decomposition pressure of intermetallic compound $TcZn_4$ in, at 470 to 570°C, 18: 23488

TECHNETIUM ISOTOPES Tc-95
- gamma spectra of metastable and ground-state, 18: 24585(R) (IDO-16969)

TECHNOLOGY
- index to conferences on nuclear, 1957 through 1963, 18: 25005 (TID-4043(Rev.1))

TELEVISION EQUIPMENT
- performance for particle track analysis in emulsion, 18: 23941
- performance for particle track analysis in nuclear emulsion, 18: 23942

TELLURIUM COMPOUNDS
- organic, preparation by beta decay of antimony-125 in organic antimony compounds, 18: 23695

TELLURIUM ISOTOPES Te-121
- electron-capture decay scheme of, 18: 24683

TELLURIUM ISOTOPES Te-123
- lifetime of isomeric, method for measuring, 18: 24025

TELLURIUM ISOTOPES Te-125
- production of isomer of, by beta decay of antimony-125 in antimony phenyl compounds, 18: 23694

TELLURIUM SYSTEMS
- Er–Te, crystal chemistry and phase studies of, 18: 23506
- La–Te, crystal chemistry and phase studies of, 18: 23506
- Li–Te, performance in fuel cells, 18: 24355 (ANL-6802(p.53-63))
- Nd–Te, crystal chemistry and phase studies of, 18: 23506

TEMPERATURE
- calculation of transient, computer program for, 18: 23763 (ANL-6654)
- effects on brood pattern of irradiated Drosophila sperm, 18: 23279
- effects on neutron sensors, 18: 23888 (PWAC-424)
- radiation effects on adaptation to, in frogs, 18: 23307

TERBIUM
- high-temperature allotropy of, 18: 24176
- magnetic properties of, effects of crystalline field and structure on, 18: 24186
- polarographic behavior in tetraethylammonium bromide at dropping mercury electrode, 18: 23463
- proton elastic scattering at 55 Mev, effects of nuclear deformation on, 18: 24665
- separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)

TERBIUM ALLOYS
- Mg–Nb, high-temperature allotropy and phase studies on, 18: 24176

TERBIUM COMPLEXES
- laser action in, 18: 24229
- with 2,2′-dipyridyl, preparation and fluorescence and infrared spectra of, 18: 23500

TERBIUM IONS
- electron paramagnetic resonance in calcium fluorides, spin-lattice relaxation in, 18: 23527

TERBIUM ISOTOPES Tb-149
- charge distribution of, from heavy ion reactions with rare earths, 18: 24624 (UCRL-10806)

TERBIUM ISOTOPES Tb-157
- half life, 18: 24696

TERBIUM ISOTOPES Tb-159
- energy levels, 18: 24625 (WASH-1046)
- oxygen-16 scattering at 57 Mev, level excitation in, 18: 24730

TERBIUM ISOTOPES Tb-161
- production in neon-22 and oxygen-18 reactions with thorium-232, 18: 24690

TERBIUM ISOTOPES Tb-163
- production in neon-22 and oxygen-18 reactions with thorium-232, 18: 24690

TERBIUM OXIDES
- O_2–TbO_x, phase studies, 18: 23505

TERBIUM PHOSPHATES
- magnetic susceptibility at 20 to 900°K, 18: 23512

TEREPHTHALIC ACID, ETHYLENE POLYMER ESTERS
- radioinduced graft polymerization of vinyl monomers on, gamma, 18: 23657(T,R) (AEC-tr-6316(p.640-9))

TERPHENYL
- physical properties of, compiled for heat transfer calculations, 18: 2356 (EUR-1619.e)

TERRAMYCIN
- radiosensitivity effects of, effects of activation on, 18: 23380

TETRACYCLINE
- effects on calcium-47 and strontium-85 retention in mice and rats, 18: 23220
- radiosensitivity effects of, effects of activation on, 18: 23380

TETRAZOLES
- 5-mercapto-, effects on catalase, 18: 23187(R) (ANL-6823(p.91-8))
- 5-mercapto-, inhibitory effects on mouse catalase levels, 18: 23186(R) (ANL-6823(p.86-90))

TETRYL
- combustion and thermal decomposition processes in, mechanism of, 18: 25027(T) (LA-tr-64-2)

THALIDOMIDE
- malformations in infants induced by ingestion of, by mothers, 18: 25010 (TID-19257)

THALLIUM
- neutron scattering by, 18: 24625 (WASH-1046)

THALLIUM COUPLES
- Al/Pb–Tl, surface superconductivity in, 18: 24548

THALLIUM IONS
- radiolysis effects on aqueous sulfuric acid solutions, 18: 23675

THALLIUM ISOTOPES Tl-201
- fission barrier for, 18: 24670

THALLIUM ISOTOPES Tl-203
decay of, semiconductor detection of, 18: 23990
THEOPHYLLINE
protective effects against radioinduced leukopenia in rabbits, 18: 23373
THERMAL DIFFUSION
performance for isotope separation, summary, 18: 24050(R) (ORNL-3607)
THERMAL RADIATION
chemical effects on nylon, 18: 23579 (NP-13825)
THERMAL REACTORS
neutron multiplication factor in, fast, 18: 24846 (EUR-1618.e)
performance of IRT-2000, 18: 24960 (NP-13911)
reactivity compensation during samarium-149 buildup, 18: 24853(P)
safety analysis of, during excursions, 18: 23817(R) (ANL-6880(p.72-8))
THERMIONIC CELLS
cathodes for, performance of perforated, 18: 24366 (ASD-TDR-63-750)
design and performance of extended-surface, 18: 24361 (ANL-6802 (p.144-51))
development and testing of nuclear-, 18: 24369(R) (NP-13892)
development for space uses, 18: 24370(R) (PWA-2337)
development for use as electric power sources, 18: 24375
development of molybdenum–rhenium summary, 18: 24350(R) (AD-418276)
development of nuclear-, for naval reactors, 18: 24857(R) (GEST-2031)
electric insulators and spacers for nuclear, refractory oxide properties for, 18: 24367 (GEST-2022)
equipment for, design of experimental, 18: 24360 (ANL-6802(p.126-43))
ionization in plasma-diode, gamma, 18: 24373
metallurgy of developmental, 18: 24368 (JPL-TR-32-548)
performance in arc, ignited, and space-charge modes, 18: 24360 (ANL-6802(p.126-43))
performance in nuclear power systems, 18: 24927
performance of cesium- and potassium-filled, 18: 24362 (ANL-6802 (p.152-60))
THERMOCOUPLES
design for fuel elements, 18: 24871(P)
development, 18: 24937 (APEX-917)
radiation effects on, design of apparatus for studying, 18: 23840 (RT/ING(64)-2)
THERMODYNAMICS
steady-state calculations for master equations of Gaussian-Markovian processes, 18: 24233
THERMOELECTRIC CELLS
design optimization, 18: 24376
development for solar energy conversion, 18: 24353 (ANL-6802(p.24-5))
development of nuclear- and solar-powered, for space uses, 18: 24351(R) (AD-427285)
electric contacts in, resistance of, 18: 24357 (ANL-6802(p.78-86))
THERMOMETERS
calibration of immersion, for Shippingport reactor, 18: 24918 (WAPD-PWR-TE-159(Rev.))
THERMONUCLEAR EXPLOSIONS
crater nomenclature system for, 18: 25018 (UCRL-7750)
effects of large underground, on lizard population of test site, 18: 23181 (UCLA-12-522)
reported during April, 1964, 18: 23804
THERMONUCLEAR REACTORS
development, 18: 24763(R) (UCRL-11172)
development of, 1962-3, 18: 24779
performance, 18: 24797
2*H*-1,3-THIAZINE-2,4(3*H*)-DIONE, 3-(2-AMINOETHYL)-
protective effects against x radiation in mice, 18: 23370
2*H*-1,3-THIAZINE-2-THIONE-4(3*H*)-ONE, 3-(2-AMINOETHYL)-
protective effects against x radiation in mice, 18: 23370
THIAZOLIDINE-4-CARBOXYLIC ACID, 2-IMINO-
synergistic effects of, with radioprotective compounds against radiation lethality in mice, 18: 23353(R) (NP-13918(p.42-57))
THICKNESS GAGES
design of radiometric, 18: 23866(P)
radiometric, development for coating thickness measurements using x-ray fluorescence excited in coating, 18: 24046 (PAN-485/I-A)
THIOLS
protective effects of, against radiation injuries in mice, synergistic effects of amines, 18: 23385
THIOPHENE
radioinduced polymerization, gamma, 18: 23597(T,R) (AEC-tr-6316 (p.154-62))
THORITES
alpha activity in, unidentified, 18: 23802
THORIUM
analysis for nickel at 50 to 500 ppm, spectrophotometric, 18: 23414 (Y-1464)
determination in chondritic meteorites, 18: 24285
determination in chondritic meteorites, 18: 24286
determination in presence of zirconium by precipitation with iodo-phenylformic acid, 18: 23416(T) (JPRS-24593(p.10-12))
determination using solochrome azurine, colorimetric, 18: 23424
effects on determination of uranium by activation analysis, 18: 23409 (RT/CHI(63)-31))
effects on oxidation resistance of graphite, 18: 24087 (WADD-TR-61-72(Vol.XXX))
energy levels, 18: 24625 (WASH-1046)
reactions with polyacrolein, effects of pH and temperature on precipitate formation in, 18: 23542
separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)
separation by sorption on calcium oxalate, 18: 23714
uses as reactor fuel, economic aspects of, 18: 24858(R) (HW-80560F)
THORIUM ACETATES
preparation by reaction of sodium acetate and thorium nitrate, tracer studies, 18: 23543
trichloro-, preparation and properties, 18: 23543
THORIUM ALLOYS
Be–Th–U, compatibility of $(Th,U)Be_{13}$, with aluminum, 18: 24988(R) (BMI-1665(Del.))
Be–Th–U, hardness of $(Th,U)Be_{13}$, at 25 to 1500°C, 18: 24988(R) (BMI-1665(Del.))
THORIUM CARBIDES
magnetic susceptibility, 18: 24155
C–ThC–UC, separation of uranium from chlorinated, by solvent extraction, 18: 23703 (ORNL-TM-789)
ThC–UC, magnetic susceptibility, 18: 24155
THORIUM ISOTOPES Th-230
neutron fission of, fragment distributions for fast-, 18: 24620(R) (ORNL-TM-874)
THORIUM ISOTOPES Th-232
neon-22 fission at 157 Mev, fragment distributions and yields in, 18: 24735
neon-22 reactions with, yields from, 18: 24689
neon-22 reactions, yields from, 18: 24690
neutron capture, 18: 24625 (WASH-1046)
neutron fission at 15.3 Mev, analysis by nuclear emulsions, 18: 23959
neutron fission of, fragment distributions for fast-, 18: 24620(R) (ORNL-TM-874)
neutron resonance cross sections at 0.1 to 4 kev, 18: 24673
oxygen-16 reactions with, yields from, 18: 24689
oxygen-18 fission at 105 Mev, fragment distributions and yields in, 18: 24735
oxygen-18 reactions, yields from, 18: 24690
oxygen-18 reactions with, yields from, 18: 24689
use in reactor breeding elements, 18: 24929(P)
use in spiral fission chamber and method of coating foils with, 18: 24038(P)
THORIUM NITRATES
reactions with trichloroacetic acid and sodium acetates, 18: 23543
THORIUM OXIDES
deposition on aluminum, electrolytic, 18: 23537
THORIUM(IV) OXIDES
pathological effects of, in man, 18: 25004(R) (STI/DOC/10/25(p.9-69))
properties as nuclear thermionic device material, 18: 24367 (GEST-2022)
spectra in low frequency region, infrared, 18: 23549
CeO_2–Ce_2O_3–ThO_2, phase studies on, 18: 23516
CeO_2–ThO_2–Y_2O_3, phase studies on, 18: 23516
PuO_2–ThO_2, preparation and properties of pellets of, 18: 24815(R)

(MLM-1184)
ThO$_2$–UO$_2$, preparation and properties as internal conversion fuel material, 18: 24065(R) (GEMP-34A)
ThO$_2$–UO$_2$–Y$_2$O$_3$, preparation and properties as internal conversion fuel material, 18: 24065(R) (GEMP-34A)
THORIUM PHOSPHATES
preparation and properties of ortho-, existence of tetrahydrate in, 18: 23478
THORIUM PHOSPHIDES
electrostatic energy and valence bonding in, 18: 23508
THORIUM SYSTEMS
C–Th–U, hardness of (Th,U)C and (Th,U)C$_2$, at 25 to 1500°C, 18: 24988(R) (BMI-1665(Del.))
THREONINE
synthesis and transformation in uv photolysis of organic compounds in mixtures with ammonium compounds, 18: 23204(T) (JPRS-24164(p.19-42))
THRESHOLD DETECTORS
uses for measurement of fast neutron fluxes, 18: 23885 (NP-13930 (p.178-80))
THULIUM
high-temperature allotropy of, 18: 24176
magnetic properties of, effects of crystalline field and structure on, 18: 24186
polarographic behavior in tetraethylammonium bromide at dropping mercury electrode, 18: 23463
proton elastic scattering at 55 Mev, effects of nuclear deformation on, 18: 24665
thermal capacity at 0.38 to 3.9°K, 18: 23442 (CONF-405-41)
THULIUM ALLOYS
Mg–Tm, high-temperature allotropy and phase studies on, 18: 24176
THULIUM MANGANATES
magnetic properties and manganese ion moment configurations of, 18: 24128 (CONF-405-34)
magnetic structures, 18: 23523
THULIUM OXIDES
spectra in low frequency region, infrared, 18: 23549
THYMIDINE
human testicular uptake of tritiated, used to study spermatogenesis rate, 18: 23176
incorporation in human chromosomes, 18: 23201 (LFEN-N1.11)
THYMUS
radiation effects on amino acid incorporation by proteins of rat, x, 18: 23259
THYROID GLAND
iodine-131 distribution in, technique for measurement of, 18: 23218
radiation effects on growth function of rat, x, 18: 23260
THYROXINE
synthesis and transformation in uv photolysis of organic compounds in mixtures with ammonium compounds, 18: 23204(T) (JPRS-24164 (p.19-42))
TIGLALDEHYDE
nuclear spin coupling constants in, methods for determining relative signs of, 18: 23572
TIMING CIRCUITS
description of transistorized tunnel-diode low-resolution-time counters, 18: 23864
design and performance of nanosecond time selector with time-to-amplitude conversion and preselection, 18: 24016
design and performance of transistorized time-to-amplitude converter for timing of weak pulses, 18: 24017
design and performance of nanosecond time coder with large analysis range for time-of-flight experiments, 18: 24018
design and performance of transistorized time coder of 10 nsec per channel for neutron spectroscopy, 18: 24019
design and performance of transistorized time coder with large analysis range and 1 nsec width, 18: 24020
design and performance of 100-MHz digital time-of-flight system, 18: 24022
TIN
determination in small solid samples by mass spectroscopy, design of ion source for, 18: 23406 (CONF-512-4)
electron configuration of, g factors of p^3, 18: 24625 (WASH-1046)
heat of solution of neodymium, praseodymium, and samarium in, at 750°K, 18: 24183
sorption of americium-241 and protactinium-233 by, from water–ethanol solutions, 18: 23724
superconductivity of films of, 18: 24544(R) (NBS-8253)
thickness measurements of coatings of, on steel, by gamma excitation of x-ray fluorescence, 18: 24046 (PAN-485/I-A)
TIN ALLOYS
Li–Sn, performance in fuel cells, 18: 24355 (ANL-6802(p.53-63))
Mo–Sn–U, fission effects on, reduction of swelling in, 18: 24996(R) (NAA-SR-8888(Sect.VI))
Nb–Sn, superconducting magnets of, 18: 24547
Sn–Zr, development, 18: 24077(P)
TIN BROMIDES
analysis of organic, gas-liquid chromatographic, 18: 24988(R) (BMI-1665(Del.))
TIN CHLORIDES
catalytic effects on reactions of iodine chloride with trifluoroethylene, 18: 25016 (UCRL-7373)
complexes with ethyl cyanoacetate, preparation and spectra of, 18: 23471
TIN COMPOUNDS
analysis of organic, gas-liquid chromatographic, 18: 24988(R) (BMI-1665(Del.))
TIN ISOTOPES
nuclear radii of, from neutron transmission data, 18: 24620(R) (ORNL-TM-874)
TIN ISOTOPES Sn-119
oxygen-16 reactions with, coulomb excitation in, 18: 24620(R) (ORNL-TM-874)
TIN ISOTOPES Sn-120
neutron resonances below 10 kev, 18: 24620(R) (ORNL-TM-874)
TIN ISOTOPES Sn-122
neutron resonances below 10 kev, 18: 24620(R) (ORNL-TM-874)
TIN OXIDES
effects on radiation behavior of polymers, 18: 24199(T,R) (AEC-tr-6316 (p.359-67))
electron bombardment of films of, products from, 18: 24319
spectra in low frequency region, infrared, 18: 23549
TISSUE CULTURES
of hamster cells, electron microscopic studies of chromosomes in, during metaphase, 18: 25008 (TID-19032)
radiation injuries of mouse L cells in, reactivation with tissue homogenates or DNA, 18: 23367
thymidine metabolism in human cells in, 18: 23201 (LFEN-N1.11)
TISSUE HOMOGENATES
reactivation of irradiated mouse L cells by, 18: 23367
TISSUES
radiation effects on uptake of carbon-14-labeled methionine by rat, x, 18: 23293
TITANIUM
alloying effects on iron–nickel alloys, 18: 24161
coating with radioactive rare earth for use as radiation source, 18: 24
corrosion by liquid potassium chloride–sodium chloride at 700, 800, and 900°C, 18: 24089
effects on hydrogen embrittlement of steel, 18: 24153(T,R) (EURAEC-1002)
effects on phase transformations in steel, 18: 24152(T,R) (EURAEC-1001)
efficiency drift of foil of, in secondary electron monitor for linear accelerator at 15 Mev, 18: 24253
reactions with polyacrolein, effects of pH and temperature on precipitate formation in, 18: 23542
welding of, evaluation of methods for, 18: 24106(T) (JPRS-24521(p.1-5
welding of, Hanford guide to procedures, specifications, and qualification test records for, 18: 24104 (TID-20625(Vol.III))
TITANIUM ALLOY COUPLES
Mo–Si/Ti, solid state bonding of, 18: 24112
TITANIUM ALLOYS
welding of, evaluation of methods for, 18: 24106(T) (JPRS-24521(p.1-5
Cr–Nb–Ti–V, properties for use as cladding materials in nuclear super-

heat applications, 18: 24080 (BMI-X-286)
Croloy–Ti, performance in nuclear superheater environment, 18: 24884(R) (GEAP-4419)
Fe–Ti, bulk superconductivity in, 18: 24553
Mo–Ti, factors affecting vacuum-arc melting of, 18: 24070 (RTD-TDR-63-4089)
Mo–Ti, mechanical properties of, strain-softening effects on, 18: 24119 (AD-425148)
Mo–Ti, solid-state bonding of, 18: 24112
Mo–Ti–Zr, corrosion by potassium at 2000 to 2200°F, 18: 24091
Mo–Ti–Zr, factors affecting vaccum-arc melting of, 18: 24070 (RTD-TDR-63-4089)
Mo–Ti–Zr, performance as fuel cladding in fast reactors, 18: 24952(R) (ANL-6880(p.6-48))
Nb–Ti, bulk superconductivity in, 18: 24553
Nb–Ti, electric and mechanical properties, 18: 24158
Ti–V, bulk superconductivity in, 18: 24553
Ti–V, performance as fuel cladding in fast reactors, 18: 24952 (ANL-6880(p.6-48))
Ti–W, solid-state bonding of, 18: 24112
Ti–Zr, neutron inelastic scattering in, 18: 24959 (NP-13910)

TITANIUM BROMIDES
complexes with ethyl cyanoacetate, preparation and spectra of, 18: 23471

TITANIUM CARBIDES
electric properties of, rigid band model for interpreting, 18: 24137 (NP-13944)

TITANIUM CHLORIDES
complexes with ethyl cyanoacetate, preparation and spectra of, 18: 23471

TITANIUM COUPLES
Mo–Ni/Ti, solid state bonding of, 18: 24112
Mo–Ti/Ti, solid state bonding of, 18: 24112

TITANIUM ISOTOPES
deuteron reactions (d,He^3) on, 18: 24625 (WASH-1046)

TITANIUM ISOTOPES Ti-46
deuteron reactions (d,^{3}He) with, angular distributions and cross sections for, 18: 24672
deuteron reactions (d,p) at 21 Mev, interference effects in, 18: 24713
proton reactions (p,n) at 7.2 to 9.5 Mev, excited states in vanadium-46 from, 18: 24612 (NP-13930(p.134))

TITANIUM ISOTOPES Ti-47
deuteron reactions (d,^{3}He) with, angular distributions and cross sections for, 18: 24672

TITANIUM ISOTOPES Ti-48
deuteron reactions (d,^{3}He) with, angular distributions and cross sections for, 18: 24672
deuteron reactions (d,p) at 21 Mev, interference effects in, 18: 24713
deuteron reactions (d,p) with, angular distribution from, 18: 24625 (WASH-1046)
neutron elastic and inelastic scattering at 2.09 Mev, polarization in, 18: 24694
proton inelastic scattering by, resonances in, 18: 24625 (WASH-1046)

TITANIUM ISOTOPES Ti-49
deuteron reactions (d,^{3}He) with, angular distributions and cross sections for, 18: 24672

TITANIUM ISOTOPES Ti-50
deuteron reactions (d,^{3}He) with, angular distributions and cross sections for, 18: 24672
deuteron reactions (d,p) at 21 Mev, interference effects in, 18: 24713

TITANIUM NITRIDES
electric properties of, rigid band model for interpreting, 18: 24137 (NP-13944)
BN–TiN, development for high-temperature oxidation protection of tungsten, 18: 24086(R) (NP-13898)

TITANIUM OXIDES
catalytic effects on radioinduced isomerization of 2-butene, 18: 23667
effects on radiation behavior of polymers, 18: 24199(T,R) (AEC-tr-6316 (p.359-67))
spectra in low frequency region, infrared, 18: 23549

TITANIUM SYSTEMS
Cr–Si–Ti, protective effects on B-66 and D-43 niobium alloys, 18: 24068(R) (NP-13955)
O–Si–Ti–W–Zr, development for high-temperature oxidation protection of tungsten, 18: 24086(R) (NP-13898)

TOLUENE, TRINITRO-
combustion and thermal decomposition processes in, mechanism of, 18: 25027(T) (LA-tr-64-2)

TOPAZES
spectra of, data tabulation of x-ray-fluorescence, 18: 24216 (Y-1470-B)

TOXICITY
of radionuclides in beagles, 18: 23184(R) (ANL-6823(p.44-75))

TRACER TECHNIQUES (AGRICULTURE)
development, 18: 25004(R) (STI/DOC/10/25(p.9-69))
for measuring water uptake by soil, 18: 24045

TRACER TECHNIQUES (ENGINEERING)
for hydrology and soil moisture measurements, bibliography on, 18: 24044 (NP-13931)
for sewage dilution and flow studies, 18: 24043 (INS-R-14)
quality control in manufacture of printed circuit boards, 18: 23841 (TID-20183)
use in fabrication of photomultiplier tubes with silver alloy dynodes, 18: 23865
uses in flow measurements in pipes, 18: 23762 (AERE-R-4623)

TRACER TECHNIQUES (MEDICINE)
development and standardization, 18: 25004(R) (STI/DOC/10/25(p.9-69))
development of, for tropical medicine, 18: 23168(R) (STI/DOC/10/25 (p.99-111))

TRACER TECHNIQUES (OCEANOGRAPHY)
for sea-drifter studies at Solway Firth, 18: 23785 (PG-Report-577)

TRANSDUCERS
development and operation of pressure, 18: 24855(R) (GEAP-3771-12)

TRANSISTORS
electric current lifetimes in, measurement of, 18: 23756

TRANSITION METALS
alloying with rare earths, effects of atomic number on Laves phases in, 18: 24126 (CONF-405-32)
electron theory of, review of, 18: 24305

TRANSURANIC ELEMENTS
separation from irradiated aluminum–plutonium alloys by ion exchange, 18: 23702 (ORNL-3566)
separation from rare earths, chromatographic, 18: 23722

TREES
radiosensitivity of seeds of, 18: 23312

***s*-TRIAZINE, HEXAHYDROTRINITRO-**
combustion and thermal decomposition processes in, mechanism of, 18: 25027(T) (LA-tr-64-2)

1,2,4-TRIAZOLE, 3-AMINO-
5-mercapto-, inhibitory effects on mouse catalase levels, 18: 23186(R) (ANL-6823(p.86-90))

TRIOCTYLAMINE
hydrogen bond formation and stability in, spectroscopic studies of, 18: 23576
reactions with nitric acid, isotope effects in, 18: 23576
reactions with uranyl nitrate, stoichiometry of compound formed in, 18: 23544
uses in chromatographic separation of rare earths, 18: 23709(T) (JPRS-24552(p.57-9))

TRIOXANES
radioinduced polymerization, 18: 23602(T,R) (AEC-tr-6316(p.182-5))
radioinduced polymerization, effects of solvents on, 18: 23605(T,R) (AEC-tr-6316(p.201-7))
radioinduced solid-state polymerization, 18: 23606(T,R) (AEC-tr-6316 (p.208-11))
structure of polymers of, prepared by radioinduced solid-state polymerization, 18: 24148(T,R) (AEC-tr-6316(p.212-16))

TRITIUM
determination in soils, liquid scintillation counting method for, 18: 23419
determination in urine, 18: 23812 (AERE-R-4528(p.35-47))
deuteron reactions (d,n) with, efficiency as neutron source, 18: 24579
deuteron reactions with, polarization in, 18: 24680
deuteron reactions (d,p) with, 18: 24625 (WASH-1046)

disposal management in wastes from fuel processing, 18: 24978 (ORNL-TM-851)
dissociation and ionization, analysis of, 18: 24797
effects on nucleic acid metabolism in tumor cells from mice, 18: 23215
exchange with hydrogen in keratins, 18: 23211
excitation effects on emission characteristics of zinc sulfide phosphors, 18: 23693
gamma reactions (γ,d) with, nucleon rigid-core analysis of, 18: 24705
incorporation in Artemisia ketones, 18: 23564
incorporation into titanium, for use in D-T neutron sources, 18: 24579
pathological effects of, in man, 18: 23812 (AERE-R-4528(p.35-47))

TRITONS
emission in lithium reactions with boron-10 and -11 at 3.5 to 4.5 Mev, angular distributions for, 18: 24720
emission in lithium-7 reactions with light nuclei at 73.5 Mev, spectra of, 18: 24723
photodisintegration of, final-state (n-n) interaction effects on cross section for three-particle, 18: 24632
reactions (t,n) with deuterium, efficiency as neutron source, 18: 24579
reactions with calcium-48, cross sections for production of 4 and 6 neutron nuclei in, 18: 24616 (NP-13964)
reactions with magnesium isotopes, 18: 24625 (WASH-1046)

TROPOSPHERE
fallout transport mechanisms in, 18: 23799

TRYPTOPHAN
photolysis of, transformation of amino acids in uv, 18: 23204(T) (JPRS-24164(p.19-42))
synthesis and transformation in uv photolysis of organic compounds in mixtures with ammonium compounds, 18: 23204(T) (JPRS-24164 (p.19-42))

TUBES
fabrication of impermeable composite carbon, 18: 24117(P)

TUMORS
chemotherapy of, potentiation by water-d_2, 18: 23209
dietary effects of cesium-137 and strontium-90 on tolerance of mice to, 18: 23210
growth of, effects of fatty acids from liver of irradiated rabbits on, in mice, 18: 23208
induction by radiation and hydrocarbons in rodents, 18: 23349
nucleic acid metabolism in isolated cells of, effects of tritium on, 18: 23215
radiodiagnosis of pancreatic, 18: 23392
radioinduced in mice, protective effects of diethylenetriaminepentaacetic acid against, plutonium, 18: 23351(R) (ANL-6823(p.114-15))
radioinduced in rats, plutonium, 18: 23232(R) (ANL-6823(p.81-5))
radioinduced mouse thymic, gamma and neutron, 18: 23230(R) (ANL-6823(p.15-19))
radioinduced rat mammary and pituitary, astatine-211, 18: 23261
radiotherapy of, effects on sodium thiocyanate space, 18: 23285

TUNGSTATES
uses of ammonium, in electrophoretic separation of alkali metals, 18: 23729

TUNGSTEN
coating of, for protection against high-temperature oxidation, 18: 24086(R) (NP-13898)
coating with copper, tantalum, and tantalum boride-carbide, 18: 23740(R) (NP-13899)
deformation characteristics under fluid pressure, 18: 24118 (AD-418388)
densification of powders of, 18: 23740(R) (NP-13899)
deposition by pyrolysis and reduction, analysis of, 18: 23451 (UCRL-7667)
emissivity of coated, in vacuum, 18: 24138(R) (PWA-2206(Vol.I))
emissivity of coated, in vacuum, 18: 24139(R) (PWA-2206(Vol.II))
emissivity of coated, in vacuum, 18: 24140(R) (PWA-2206(Vol.III))
fabrication and properties of drawn and extruded tubular, 18: 24066(R) (NMI-2126)
fabrication and properties of drawn and extruded tubular, 18: 24067(R) (NMI-2127)
mechanical properties of powder-metallurgy, effects of annealing and grain size on, 18: 24123 (ASD-TDR-63-676)
melting of, effects of additives, arc current, and electrode density on vacuum-arc, 18: 24070 (RTD-TDR-63-4089)
neutron capture resonance parameters for, 18: 24625 (WASH-1046)
neutron resonances at 4 to 27 ev, parameters for, 18: 24620(R) (ORNL-TM-874)
performance as electrodes in ion engines in spacecraft, 18: 23740(R) (NP-13899)
performance of nuclear emulsions loaded with, 18: 23920
photofission at 300 to 1000 Mev, cross sections for, 18: 24655
proton elastic scattering at 55 Mev, effects of nuclear deformation on, 18: 24665
separation from neodymium by ion exchange and solvent extraction, 18: 24856(R) (GEAP-4430)
sputtering by potassium ions at 750 to 2500 ev, tracer studies of cathodic, 18: 24776
tensile properties of, effects of strain softening on, 18: 24119 (AD-425148)

TUNGSTEN ALLOYS
Hf–Ta–W, factors affecting vacuum-arc melting of, 18: 24070 (RTD-TDR-63-4089)
Mo–Nb–W, factors affecting vacuum-arc melting of, 18: 24070 (RTD-TDR-63-4089)
Mo–W, factors affecting vacuum-arc melting of, 18: 24070 (RTD-TDR-63-4089)
Nb–Re–W, factors affecting vacuum-arc melting of, 18: 24070 (RTD-TDR-63-4089)
Nb–Ta–W–Zr, fabrication and properties of forged and rolled FS-85, 18: 24093(R) (AD-424593)
Nb–W, electric and mechanical properties, 18: 24158
Nb–W, factors affecting vacuum-arc melting of, 18: 24070 (RTD-TDR-63-4089)
Nb–W, solid-state bonding of, 18: 24112
Nb–W–Zr, fabrication and properties of coated D-43, 18: 24068(R) (NP-13955)
Ni–Nb–W, solid state bonding of, 18: 24112
Ni–W, solid-state bonding of, 18: 24112
Re–W, fabrication and properties of drawn and extruded tubular, 18: 24066(R) (NMI-2126)
Re–W, fabrication and properties of drawn and extruded tubular, 18: 24067(R) (NMI-2127)
Ti–W, solid-state bonding of, 18: 24112

TUNGSTEN CARBIDES
Co–WC, structure of, 18: 24175

TUNGSTEN CHLORIDES
pyrolysis of, tungsten plating by, 18: 23451 (UCRL-7667)
reduction by hydrogen, tungsten plating by, 18: 23451 (UCRL-7667)

TUNGSTEN COUPLES
Re–W/W, development of thermocouples of, 18: 24937 (APEX-917)

TUNGSTEN ELECTRODES
performance in thermionic cells, 18: 24360 (ANL-6802(p.126-43))
performance of perforated, as ion sources, 18: 24366 (ASD-TDR-63-750)

TUNGSTEN FLUORIDES
pyrolysis of, tungsten plating by, 18: 23451 (UCRL-7667)
reduction by hydrogen, tungsten plating by, 18: 23451 (UCRL-7667)

TUNGSTEN ISOTOPES
proton fission at 660 Mev, detection of, 18: 23920

TUNGSTEN ISOTOPES W-182
neutron resonance capture at 100 to 500 ev, 18: 24571(R) (RPI-328-6)

TUNGSTEN ISOTOPES W-183
neutron resonance capture at 100 to 500 ev, 18: 24571(R) (RPI-328-6)
proton elastic scattering at 55 Mev, effects of nuclear deformation on, 18: 24665

TUNGSTEN ISOTOPES W-184
energy levels, 18: 24625 (WASH-1046)
neutron resonance capture at 100 to 500 ev, 18: 24571(R) (RPI-328-6)

TUNGSTEN ISOTOPES W-186
energy levels of, g factor of 2^+, 18: 24625 (WASH-1046)
neutron resonance capture at 100 to 500 ev, 18: 24571(R) (RPI-328-6)

TUNGSTEN OXIDES
spectra in low frequency region, infrared, 18: 23549

TUNGSTEN SILICIDES
development for high-temperature oxidation protection of tungsten, 18: 24086(R) (NP-13898)
shear modulus and sound velocity of, 18: 24174

thermal expansion of, mean coefficient of, 18: 24173

TUNGSTEN SYSTEMS

C–Mo–Nb–W–Zr, corrosion by potassium at 2000 to 2200°F, 18: 24091

C–Nb–W–Y–Zr, corrosion by potassium at 2000 to 2200°F, 18: 24091

O–Si–Ti–W–Zr, development for high-temperature oxidation protection of tungsten, 18: 24086(R) (NP-13898)

O–Si–W, development for high-temperature oxidation protection of tungsten, 18: 24086(R) (NP-13898)

W–UO$_2$, fabrication and simultaneous cladding by high-velocity co-extrusion, 18: 24101 (LAMS-3065)

TURBINES

rotors for, rotary damping in stability of flexible, 18: 23749 (TID-7690(p.313-30))

U

ULTRAVIOLET RADIATION

chemical effects on nylon, 18: 23579 (NP-13825)

chemical effects on free radicals in polymers, 18: 23653(T,R) (AEC-tr-6316(p.598-602))

chemical effects on reactions of iodine chloride with trifluoroethylene, 18: 25016 (UCRL-7373)

gynogenetic effects in vertebrates, 18: 23335

synthesis and transformation of amino acids induced by, 18: 23204(T) (JPRS-24164(p.19-42))

UNDERGROUND EXPLOSIONS

crater formation in chemical and nuclear, depth-of-burst curves for, 18: 23752 (UCRL-7793)

crater nomenclature system for, 18: 25018 (UCRL-7750)

effects on physical properties of granites, 18: 23786 (UCRL-13105)

hydrodynamic properties of nuclear, 18: 23783 (NP-13943(p.209-14))

uses in mining, evaluation of characteristics for, 18: 23751 (UCRL-7350)

UNDERGROUND STRUCTURES

detection of artificial and natural, methods for, 18: 23781 (NP-13943)

URANIUM

analysis of irradiated, for iodine-131 and iodine-132, by gamma spectroscopy, 18: 23432

content of ancient man-made glass, 18: 23547

content of the western Mediterranean, 18: 23787

corrosion by liquid potassium chloride–sodium chloride at 700, 800, and 900°C, 18: 24089

determination by activation analysis in presence of thorium, 18: 23409 (RT/CHI(63)-31))

determination in biological materials, radiochemical, 18: 23405 (CEA-R-2415)

determination in chondritic meteorites, 18: 24285

determination in chondritic meteorites, 18: 24286

diffusion in uranyl sulfate anion exchange resin system, 18: 23710

dislocations in alpha, formation mechanism of, 18: 24201(T) (ANL-Trans-22)

electron bombardment at 8 to 13 Mev, delayed neutron yields in, 18: 24574

grain size testing of, standardization and evaluation of ultrasonic equipment for, 18: 24132 (HW-81752)

hardness at 300 to 800°C, 18: 24067(R) (NMI-2127)

leachability from irradiated coated fuel particles, 18: 24988(R) (BMI-1665(Del.))

neutron reactions with, neutron yield in, 18: 24625 (WASH-1046)

neutron resonance integrals for, 18: 24625 (WASH-1046)

performance as zero-power reactor fuel, 18: 24952(R) (ANL-6880 (p.6-48))

radioinduced gas bubble growth in, effects of heating from 300 to 1000°C on, 18: 24187 (AERE-R-2935)

reactions with polyacrolein, effects of pH and temperature on precipitate formation in, 18: 23542

reactivity of natural, in critical assemblies, 18: 24865(T,R) (EURAEC-992)

separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)

separation from chlorination products of graphite–thorium carbide–uranium carbide fuels by solvent extraction, 18: 23703 (ORNL-TM-789)

separation from clays by leaching with calcium chloride and sodium bicarbonate solutions, 18: 23711

separation from fuels, by fluoride volatility method, 18: 24813(R) (ANL-6880(p.49-67))

separation from irradiated uranium dioxide fuels by chloride volatility methods, 18: 23704 (ORNL-TM-828)

separation from sulfuric acid solutions by anion exchange, diffusion coefficient in, 18: 23710

separation of neptunium-239 and ruthenium-106 from, by ion exchange, 18: 23726

sorption and exchange in peat, 18: 23806

use in heavy water reactors, cost analysis for, 18: 24905 (NP-13905)

uses as reactor fuel, economic aspects of, 18: 24858(R) (HW-80560F)

URANIUM ACETATES

diffusion into nuclear emulsions, 18: 23553

URANIUM ALLOYS

Al–Fe–U, phase studies, 18: 24135(R) (NMI-2812)

Al–Fe–U, radiation induced growth in, 18: 24204

Al–Pu–U, performance as zero-power reactor fuel, 18: 24952(R) (ANL-6880(p.6-48))

Al–U, phase studies, 18: 24135(R) (NMI-2812)

Al–U, reactions with steam at 1200 to 1600°C, 18: 23817(R) (ANL-6880(p.72-8))

Be–Th–U, compatibility of (Th$_4$U)Be$_{13}$, with aluminum, 18: 24988(R) (BMI-1665(Del.))

Be–Th–U, hardness of (Th$_4$U)Be$_{13}$, at 25 to 1500°C, 18: 24988(R) (BMI-1665(Del.))

Be–U, fabrication of splat-cooled, 18: 24066(R) (NMI-2126)

Be–U, hardness of cast and splat-cooled, at 600°C, 18: 24066(R) (NMI-2126)

Be–U, hardness of splat-cooled, at 20 to 800°C, 18: 24067(R) (NMI-2127)

Cu–Pu–U, performance as zero-power reactor fuel, 18: 24952(R) (ANL-6880(p.6-48))

Fe–Pu–U, performance as zero-power reactor fuel, 18: 24952(R) (ANL-6880(p.6-48))

Fe–U, phase studies, 18: 24135(R) (NMI-2812)

fissium–Pu–U, development for fast reactor fuels, 18: 24952(R) (ANL-6880(p.6-48))

fissium–Pu–U, performance as zero-power reactor fuel, 18: 24952(R) (ANL-6880(p.6-48))

Mo–Pu–U, performance as zero-power reactor fuel, 18: 24952(R) (ANL-6880(p.6-48))

Mo–Sn–U, fission effects on, reduction of swelling in, 18: 24996(R) (NAA-SR-8888(Sect.VI))

Mo–U, evaluation as HNPF fuel, 18: 24892(R) (NAA-SR-8888(Sect.II))

Mo–U, phase transformations in, 18: 24124 (CEA-2341)

Nb–U, phase transformations in, 18: 24124 (CEA-2341)

Pu–U, development for fast reactor fuels, 18: 24952(R) (ANL-6880 (p.6-48))

Pu–U, performance as zero-power reactor fuel, 18: 24952(R) (ANL-6880(p.6-48))

Pu–U, reactivity in critical assemblies, 18: 24865(T,R) (EURAEC-992)

Pu–U–Zr, performance as zero-power reactor fuel, 18: 24952(R) (ANL-6880(p.6-48))

U–Zr, disintegration in mixtures of argon and oxygen and argon and nitrogen, droplet study of, 18: 24933 (AFSWC-TDR-63-51)

U–Zr, processing of irradiated, equipment contamination and decontamination in, 18: 23705 (ORNL-TM-837)

URANIUM CARBIDES

analysis of, methods and equipment for chemical and metallographic, 18: 23404 (AI-8700(Vol.V))

development for SGR, 18: 24891(R) (NAA-SR-8888(Sect.I))

electric conductivity at high temperatures, 18: 23837 (CEA-R-2402)

fabrication by skull casting and dry machining, 18: 24097 (AI-8700 (Vol.III))

fabrication for use as fuel in Sodium Graphite Reactor, cost analysis of, 18: 24095 (AI-8700(Vol.I))

fabrication into pellets, 18: 24813(R) (ANL-6880(p.49-67))

fabrication of stainless steel-clad sodium-bonded, economics of, 18: 24098 (AI-8700(Vol.IV))

fabrication of, for Hallam Power Reactor, 18: 24892(R) (NAA-SR-8888(Sect.II))

fission gas release from irradiated, at 1000 to 1600°C, 18: 24988(R) (BMI-1665(Del.))
hydrolysis of, mechanisms and products of, 18: 23461(T) (ORNL-tr-122)
magnetic susceptibility, 18: 24155
meltdown of niobium–zirconium clad, in TREAT, 18: 23817(R) (ANL-6880(p.72-8))
phase studies, 18: 24133 (LADC-6391)
preparation, 18: 24813(R) (ANL-6880(p.49-67))
preparation and properties of dicarbide, 18: 23565
preparation by reaction of graphite and uranium dioxide for fuel element fabrication, 18: 24096 (AI-8700(Vol.II))
preparation of single-crystal, 18: 24996(R) (NAA-SR-8888(Sect.VI))
processing using carbothermic reduction, 18: 23701(R) (NAA-SR-8888 (Sect.V))
properties as reactor fuels, 18: 24860(R) (UNC-5071)
radiation effects on sintered pellets of, in-pile, 18: 24072(T,R) (EURAEC-934)
C–ThC–UC, separation of uranium from chlorinated, by solvent extraction, 18: 23703 (ORNL-TM-789)
PuC–UC, burnup testing, 18: 24988(R) (BMI-1665(Del.))
ThC–UC, magnetic susceptibility, 18: 24155
UC–ZrC, compatibility with stainless steel–zirconium carbide, 18: 24072(T,R) (EURAEC-934)
UC–ZrC, phase studies, 18: 24133 (LADC-6391)

URANIUM(IV) CHLORIDE COMPLEXES
with dimethylformamide, preparation and polarographic reduction of, 18: 23473

URANIUM COMPLEXES
with dimethylformamide, preparation and polarographic reduction, 18: 23473

URANIUM FLUORIDES
determination in deposits on plant equipment, design of neutron counter for, 18: 23875 (K-1586)

URANIUM(VI) FLUORIDES
separation from gas mixtures, design of apparatus for, 18: 23737(P)

URANIUM IONS
complexes of tetravalent with halide, perchlorate, and sulfate ions, stability constants of, 18: 23534
determination of hexavalent, spectrophotometric, 18: 23429
oxidation of tetravalent, by potassium chlorate in perchloric acid solutions, 18: 23541

URANIUM ISOTOPES
separation by gaseous diffusion, economics of, 18: 24054(T) (ORNL-tr-134)

URANIUM ISOTOPES U-233
fission rate in graphite-moderated assembly, 18: 24852
neutron capture-to-fission ratio of, measurement of, 18: 24625 (WASH-1046)
neutron fission of, energy dependence of number of neutrons from, 18: 24640
proton fission of, 18: 24625 (WASH-1046)
separation from breeder elements, process for, 18: 24929(P)

URANIUM ISOTOPES U-234
neutron fission of, fragment distributions for fast-, 18: 24620(R) (ORNL-TM-874)
neutron fission of, product angular anisotropies for, 18: 24625 (WASH-1046)
proton fission of, 18: 24625 (WASH-1046)

URANIUM ISOTOPES U-235
burnup from irradiated coated fuel particles, 18: 24988(R) (BMI-1665(Del.))
fission by thermal neutrons, angular distributions and energy spectra of neutrons emitted in, 18: 24697
fission rate in graphite-moderated assembly, 18: 24852
helium ion reactions (He-3, He-4) at 25 Mev, 18: 24625 (WASH-1046)
neutron fission cross sections for oriented, multilevel effects in, 18: 24620(R) (ORNL-TM-874)
neutron fission of, cross sections for thermal, 18: 24578
neutron fission of, fractional independent yield of antimony-127 from, 18: 24677
neutron fission of, neutron emission by fragments from thermal, 18: 24701
neutron fission of, alpha particles and fission fragments from, 18: 24625 (WASH-1046)
neutron fission of, energy dependence of number of neutrons from, 18: 24640
neutron resonance absorption and fission cross sections for, 18: 24589 (KAPL-M-6131)
proton fission of, 18: 24625 (WASH-1046)
separation from uranium-238, costs for, 18: 24866

URANIUM ISOTOPES U-236
neutron fission of, fragment distributions for fast-, 18: 24620(R) (ORNL-TM-874)
neutron fission of, product angular anisotropies for, 18: 24625 (WASH-1046)
proton fission of, 18: 24625 (WASH-1046)

URANIUM ISOTOPES U-238
ion reactions at 90 to 150 Mev, production of spontaneously fissioning isomer in, 18: 24725
neon-22 fission at 147 Mev, fragment distributions and yields in, 18: 24735
neon-22 reactions with, yields from, 18: 24689
neutron capture, 18: 24625 (WASH-1046)
neutron fission of, fragment distributions for fast-, 18: 24620(R) (ORNL-TM-874)
neutron fission of, energy dependence of number of neutrons from, 18: 24640
neutron resonance absorption cross sections for, computer program for calculating, 18: 24589 (KAPL-M-6131)
neutron resonance cross sections at 0.1 to 4 kev, 18: 24673
neutron resonance level parameters of, 18: 24625 (WASH-1046)
neutron resonance parameters for, 18: 24861 (WCAP-6060)
oxygen-16 reactions with, yields from, 18: 24689
oxygen-18 reactions with, yields from, 18: 24689
proton fission of, 18: 24625 (WASH-1046)
separation from uranium-235, costs for, 18: 24866
use in measurement of Doppler coefficients of reactivity, 18: 24816(R) (NAA-SR-8888(Sect.IV))
use in reactor breeding elements, 18: 24929(P)

URANIUM NITRATES
diffusion into nuclear emulsions, 18: 23553

URANIUM NITRIDES
phase diagrams and thermodynamic properties of, 18: 23454(R) (UNC-5077)

URANIUM ORES
analysis of, radiochemical, 18: 25004(R) (STI/DOC/10/25(p.9-69))

URANIUM OXIDES
analysis for oxygen/metal ratios, 18: 23403 (AERE-R-4608)
deposition on metals by electrolysis in sodium fluoride, 18: 23557

URANIUM(IV) OXIDES
coating of particles of, with porous and impermeable layers of aluminum oxide, 18: 24115(P)
deposition on aluminum, electrolytic, 18: 23537
fabrication into fuel tubes, 18: 24882(R) (DP-905)
fission product migration in, 18: 24856(R) (GEAP-4430)
grain growth, 18: 24855(R) (GEAP-3771-12)
melting point, 18: 24855(R) (GEAP-3771-12)
performance as reactor fuels, 18: 24854(R) (CEND-2863-211)
preparation from alkaline uranyl carbonate solutions, 18: 23436 (CEA-R-2414)
preparation of crystals of, by electrolysis of fused chlorides at 450 to 550°C, 18: 23458(T) (HW-tr-71)
processing, 18: 23701(R) (NAA-SR-8888(Sect.V))
properties as reactor fuel, 18: 24855(R) (GEAP-3771-12)
properties of spherical powders of, 18: 24988(R) (BMI-1665(Del.))
radiation effects on nichrome-clad wires of, 18: 24189 (APEX-730)
sintering in hydrogen, effects on grain size gradient and oxygen/uranium ratio in pellets from, 18: 24109
PuO_2–UO_2, preparation for reactor fuel, 18: 24868(P)
ThO_2–UO_2, preparation and properties as internal conversion fuel material, 18: 24065(R) (GEMP-34A)
ThO_2–UO_2–Y_2O_3, preparation and properties as internal conversion fuel material, 18: 24065(R) (GEMP-34A)
UO_2–Y_2O_3, preparation and properties as internal conversion fuel

  material, 18: 24065(R) (GEMP-34A)
  UO_2–Y_2O_3–ZrO_2, preparation and properties as internal conversion fuel material, 18: 24065(R) (GEMP-34A)
  W–UO_2, fabrication and simultaneous cladding by high-velocity co-extrusion, 18: 24101 (LAMS-3065)

URANIUM(IV-VI) OXIDES
  electric conductivity of delta-phase, at 26 to 620°C, 18: 24120 (AEET/CD/21)
  oxidation of, analysis of uranium trioxide modifications formed in, 18: 23475
  reactions with aluminum, analysis of "thermite", 18: 23817(R) (ANL-6880(p.72-8))
  thermoelectric power of delta-phase, at 35 to 398°C, 18: 24120 (AEET/CD/21)
  Gd_2O_3–U_3O_8, crystal structure of compacts of, 18: 24813(R) (ANL-6880(p.49-67))

URANIUM(VI) OXIDES
  phase modifications of, formed in oxidation of uranium(IV-VI) oxide, 18: 23475

URANIUM SULFIDES
  thermal properties, 18: 24813(R) (ANL-6880(p.49-67))

URANIUM SYSTEMS
  Al–Si–U, fabrication by casting and splat cooling, 18: 24066(R) (NMI-2126)
  Al–Si–U, fabrication and properties of hot-pressed and splat-cooled, 18: 24067(R) (NMI-2127)
  Al–Si–U, hardness of splat-cooled, at 600°C, 18: 24066(R) (NMI-2126)
  Be–C–U, fabrication by casting, extrusion, and splat cooling, 18: 24066(R) (NMI-2126)
  Be–C–U, fabrication and properties of cast, extruded, and splat-cooled, 18: 24067(R) (NMI-2127)
  Be–C–U, hardness of cast, extruded, and splat-cooled, at 500 and 600°C, 18: 24066(R) (NMI-2126)
  C–Pu–U, performance as zero-power reactor fuel, 18: 24952(R) (ANL-6880(p.6-48))
  C–Th–U, hardness of (Th,U)C and $(Th,U)C_2$, at 25 to 1500°C, 18: 24988(R) (BMI-1665(Del.))
  Mo–Si–U, fission effects on, reduction of swelling in, 18: 24996(R) (NAA-SR-8888(Sect.VI))

URANYL ACETATES
  polarographic reduction, 18: 23473

URANYL CARBONATES
  reduction of alkaline solutions of, to uranium oxide, 18: 23436 (CEA-R-2414)

URANYL CHLORIDE COMPLEXES
  with dimethylformamide, preparation and polarographic reduction of, 18: 23473

URANYL CHLORIDES
  separation from nitric acid solutions by solvent extraction using dioctyl sulfoxide, 18: 23716

URANYL IONS
  energy transfer to neodymium ions in barium crown glass, radiationless resonance, 18: 24223

URANYL NITRATE COMPLEXES
  with cesium nitrates, infrared spectra and structure of, 18: 23535
  with pyridine, infrared spectra and structure of, 18: 23535

URANYL NITRATES
  effects on microstructure of renal tubes in mice, 18: 23214
  effects on 1,6-diphosphoaldolase fructose activity in mouse kidney, 18: 23213
  reactions with trioctylamine, stoichiometry of compound formed in, 18: 23544
  separation from nitric acid solutions by solvent extraction using dioctyl sulfoxide, 18: 23716
  separation using TBP, 18: 23738(P)
  solubility in tributyl phosphate, 18: 23713

URANYL SULFATES
  diffusion of uranium in, in anion exchange resin system, 18: 23710

UREA
  effects on radioinduced polymerization of acrylonitrile, 18: 23639(T,R) (AEC-tr-6316(p.465-8))
  photolysis in mixtures with ammonium compounds, formation of amino acids in uv, 18: 23204(T) (JPRS-24164(p.19-42))
  protective effects against radiation damage to plant cells, 18: 23374

UREA, THIO-
  protective effects against radiation damage to plant cells, 18: 23374

URINE
  analysis for barium-140, radium-226, and strontium-90 by ion exchange, 18: 23421
  analysis for taurine using autoanalyzer, 18: 25007 (TID-18929)
  analysis for tritium, 18: 23812 (AERE-R-4528(p.35-47))
  excretion of taurine and sulfate in rat, effects of adrenal hormones on, 18: 25006 (TID-18927)
  radiation effects on excretion of creatine and 2-methyl-β-alanine in rats, 18: 23234 (EUR-591.d)
  radiation effects on ovaries, effects on estrogens in, 18: 23346
  radiation effects on excretion of deoxycytidine in rat, 18: 23382

V

VACCINES
  radiosensitivity effects of flu-virus, in mice treated by bone marrow injections, 18: 23366

VACUUM SYSTEMS
  design for preparing and studying thin metallic films, 18: 24225

VALINE
  synthesis and transformation in uv photolysis of organic compounds in mixtures with ammonium compounds, 18: 23204(T) (JPRS-24164 (p.19-42))

VALLECITOS BOILING WATER REACTOR
  fuel element development and testing, 18: 24885(R) (GEAP-4488)
  fuels and materials testing for, 18: 24886(R) (GEAP-4565)
  fuels and materials testing in, 18: 24884(R) (GEAP-4419)

VALLECITOS SUPERHEAT REACTOR
  fuels and materials testing for, 18: 24886(R) (GEAP-4565)
  fuels and materials testing in, 18: 24884(R) (GEAP-4419)

VALVES
  design and testing for hydraulic reactor control systems, 18: 24820(R) (GNEC-337)
  testing of hydraulic system for butterfly, in Shippingport Pressurized Water Reactor, 18: 24880 (DLCS-3570501)

VAN ALLEN RADIATION BELTS
  electron acceleration in, 18: 24332
  electron velocity distributions in, effects of vlf electromagnetic oscillations on, 18: 24519

VAN DE GRAAFF ACCELERATORS
  beam current measurement during operation, 18: 24251(T,R) (AEC-tr-6316(p.425-30))
  characteristics of 3-Mev, 18: 24250(T,R) (AEC-tr-6316(p.413-24))
  research programs using, at Karlsruhe, 18: 24246 (NP-13930(p.137-8))
  terminal voltage measurements on, using generating voltmeter, 18: 24242 (CONF-22-33)

VANADIUM
  effects on hydrogen embrittlement of steel, 18: 24153(T,R) (EURAEC-1002)
  effects on phase transformations in steel, 18: 24152(T,R) (EURAEC-1001)
  neutron scattering by, spectra from inelastic, 18: 24605 (NP-13930(p.59-71))
  performance as fuel cladding in fast reactors, 18: 24952(R) (ANL-6880(p.6-48))
  phonon spectra, 18: 24959 (NP-13910)
  reduction of neptunium by, in perchloric acid, kinetics and thermodynamics of, 18: 23485
  vanadium-51 NMR in, temperature dependence of, 18: 24688

VANADIUM ALLOYS
  Cr–Nb–Ti–V, properties for use as cladding materials in nuclear superheat applications, 18: 24080 (BMI-X-286)
  Mo–Nb–V–Zr, fabrication and properties of coated B-66, 18: 24068(R) (NP-13955)
  Mo–Nb–V–Zr, fabrication of extruded B-66, 18: 24093(R) (AD-424593)
  Ti–V, bulk superconductivity in, 18: 24553
  Ti–V, performance as fuel cladding in fast reactors, 18: 24952(R) (ANL-6880(p.6-48))

V–Zr, corrosion by steam at 400°C, 18: 24150(T,R) (EURAEC-538)
V–Zr, phase studies and properties of extruded, effects of annealing, quenching, and tempering on, 18: 24150(T,R) (EURAEC-538)

VANADIUM COMPOUNDS
preparation of plutonate, with perovskite structure, 18: 23521(P)

VANADIUM HYDRIDES
neutron scattering by, spectra from inelastic, 18: 24605 (NP-13930 (p.59-71))

VANADIUM ISOTOPES V-46
energy levels of, excitation in proton reactions (p,n) with titanium-46, 18: 24612 (NP-13930(p.134))

VANADIUM ISOTOPES V-51
nuclear magnetic resonance of, temperature dependence of, 18: 24688
proton reactions (p,n) at 1.6 to 2.2 Mev, yields from, 18: 24591(R) (LMSC-4-50-62-1)

VANADIUM OXIDES
catalytic effects on radioinduced isomerization of 2-butene, 18: 23667
spectra in low frequency region, infrared, 18: 23549

VAPOR PRESSURE
bibliography on Knudsen effusion method of measuring, 1940 to 1962, 18: 23446 (LA-3006)

VEHICLES
weighing system for moving railway, radiometric, 18: 24047(P)

VELA PROJECT
conference on high-frequency seismic energy, Lakewood, Colorado, October 15 and 16, 1962, 18: 23784 (NP-13956)

VINYL ALCOHOL POLYMERS
effects of irradiation followed by heating on gel formation in, 18: 24198(T,R) (AEC-tr-6316(p.118-20))
properties of, from gamma-induced polymerization of vinyl acetate, 18: 23593(T,R) (AEC-tr-6316(p.134-6))
radiation effects on gel formation and viscosity of, high-temperature, 18: 24197(T,R) (AEC-tr-6316(p.114-17))
radioinduced free radicals in, singlets in electron spin resonance spectra produced at high doses, 18: 23616(T,R) (AEC-tr-6316(p.306-9))
radioinduced free radicals in, output saturation in electron spin resonance spectra of, 18: 23617(T,R) (AEC-tr-6316(p.310-13))
radioinduced free radicals in, concentration of, 18: 23618(T,R) (AEC-tr-6316(p.314-21))
radioinduced free radicals in, electron spin resonance studies of, 18: 23649(T,R) (AEC-tr-6316(p.538-50))
radioinduced free radicals in, gamma, 18: 23651(T,R) (AEC-tr-6316 (p.573-86))
radioinduced free radicals in, gamma, 18: 23654(T,R) (AEC-tr-6316 (p.609-15))
radioinduced free radicals in, ultraviolet, 18: 23653(T,R) (AEC-tr-6316 (p.598-602))
radioinduced graft polymerization of styrene on, effects of solvents on gamma, 18: 23581(T,R) (AEC-tr-6316(p.66-9))
radioinduced graft polymerization of styrene on, effects of environment on, 18: 23582(T,R) (AEC-tr-6316(p.70-5))
radioinduced graft polymerization of vinyl monomers on, gamma, 18: 23583(T,R) (AEC-tr-6316(p.76-8))
radioinduced graft polymerization of 2-methyl-5-vinyl pyridine and styrene on, 18: 23584(T,R) (AEC-tr-6316(p.79-83))
reactions with metals, effects of pH and temperature on, 18: 23542
spectra of, effects of heating and irradiation on infrared, 18: 23590(T,R) (AEC-tr-6316(p.121-8))

VIRUSES
radiation effects on susceptibility of mice to, 18: 23248(T) (JPRS-24696)
radioinduced inactivation of, 18: 23246(T) (AERE-Trans-1000)

VOLTMETERS
description of radiometric, for Mv range, 18: 23846
use of generating, for measurement of Van de Graaff terminal voltage, 18: 24242 (CONF-22-33)

W

WASTE DISPOSAL
from radiotherapy hospital, 18: 24985
low-level radioactive, volume reduction for, 18: 24986
of solutions into ground, 18: 24979(T,R) (EURAEC-202)
of solutions into ground, 18: 24980(T,R) (EURAEC-300)

WASTE PROCESSING
calcination and solidification of high-level Purex and Redox wastes, development of equipment and techniques for, 18: 24975(R) (HW-81829)
concentrator for, dewatering property of, 18: 24984
fixation of high-level wastes in inert solid materials, 18: 24976 (LADC-6398)
flocculation, for separation of radioactive ruthenium, 18: 24983
flocculation, use of humic acid as coagulation agent in, 18: 24982
methods for, research progress in Belgium on, 18: 24979(T,R) (EURAEC-202)
methods for, research progress in Belgium on, 18: 24980(T,R) (EURAEC-300)
separation of mercury in, by amalgamation, 18: 24977 (ORNL-TM-827)
volume reduction for disposing low-level radioactive wastes, 18: 24986

WASTE SOLUTIONS
decontamination by ferric hydroxide flocculation, 18: 24981
disposal in clays and sands, 18: 24980(T,R) (EURAEC-300)
disposal in underground waters, flow measurement using tracer techniques, 18: 24979(T,R) (EURAEC-202)
disposal in underground waters, flow measurement using tracer techniques, 18: 24980(T,R) (EURAEC-300)
elution of, in bitumen, 18: 24979(T,R) (EURAEC-202)
elution of, in bitumen, 18: 24980(T,R) (EURAEC-300)
separation of cesium from, by ion exchange, 18: 23700 (DP-876)
separation of mercury from, by amalgamation with aluminum or copper, 18: 24977 (ORNL-TM-827)
separation of ruthenium from, by cellulose derivative-bentonite flocculation, 18: 24983

WATER
alpha monitoring in, apparatus for, 18: 23828(R) (UCRL-7637)
analysis for oxygen-18 by neutron activation, 18: 23426
chemistry of reactor, 18: 24886(R) (GEAP-4565)
chemistry of reactor coolant, 18: 24898 (NP-13900(Sect.3))
chemistry of reactor, 18: 24884(R) (GEAP-4419)
determination of moisture in cellulose, use of oxygen-18 exchange reaction with carbon dioxide in, 18: 23397(T,R) (AEC-tr-6316 (p.274-82))
deuterium-hydrogen exchange between heavy water and silk fibroin and, 18: 23470
diffusion into polymers, 18: 25022(T) (ANL-Trans-15)
effects on radioinduced graft polymerization of styrene on polyvinyl alcohol, 18: 23582(T,R) (AEC-tr-6316(p.70-5))
heat transfer in annular flows of subcooled, 18: 24882(R) (DP-905)
heat transfer in flows through pipes, 18: 24910(R) (SRO-101)
heat transfer to, in one- and two-phase flows through annuli, 18: 2376 (GEAP-4431)
hydrated electron reactions with, rate constants for, 18: 23691
molecular wave functions of isoelectronic sequence of, 18: 24296(R) (AD-417517)
monitoring for arsenic-76 content, automatic system for, 18: 24821 (HW-75374)
monitoring purity of reactor, system for, 18: 24932 (HW-SA-3018)
neutron inelastic scattering at 90°C, thermal, 18: 24625 (WASH-1046)
neutron moderation in, 18: 24888 (HW-SA-3507)
neutron thermalization in, 18: 24566 (NP-13912)
oxygen-18 exchange with carbon dioxide in moisture determination in cellulose, 18: 23397(T,R) (AEC-tr-6316(p.274-82))
purification for use in Hanford Production Reactors, 18: 23443 (HW-77710)
radiolysis by proton beam at 1 to 2 Mev, yields of hydrogen peroxide in, 18: 23578 (LFEN-15)
radiolysis of basic solutions of, yields from gamma, 18: 23674
radiolysis of, hydrated electron absorption spectrum and reaction consta in, 18: 23691
radiolysis of, mechanism of acidity and solute concentration effects on yields in, 18: 23681
reactions with liquid sodium in Sodium Reactor Experiment pipe gallery, hazards analysis of, 18: 24894 (NAA-SR-Memo-7743)
solubility in tributyl phosphate at 25°C, 18: 23712
steam–water, heat transfer in flows through pipes, 18: 24910(R)

(SRO-101)
thermal expansion of oxygen-18-enriched, 18: 23546
uptake by soil, tracer technique for measuring, 18: 24045
chlorobiphenyl–H_2O, settling mechanism in separation of, 18: 23452 (UCRL-10625)
Cl–O–H_2O, corrosive effects on 304 and 347 stainless steels, 18: 24125(R) (CEND-3256-209)
H_2SO_4–H_2O, radiolysis by alpha particles, 18: 23675

WATER-d_2
deuterium-hydrogen exchange between light water and silk fibroin and, 18: 23470
feasibility as moderator in light-water-cooled reactors, 18: 24882(R) (DP-905)
isotope effects on physical properties of wheat gluten due to hydrogen bonding, 18: 23477
neutron reactions with, neutron yield in, 18: 24625 (WASH-1046)
neutron spectra in, measurement of time dependence of, 18: 24571(R) (RPI-328-6)
neutron transport length in, thermal, 18: 24625 (WASH-1046)
potentiation of chemotherapy of tumors by, 18: 23209

WATER-t
determination in soils, liquid scintillation counting method for, 18: 23419

WATER COOLED REACTORS
coolant systems for, design of, 18: 24930(P)
design of heavy water-moderated steam-cooled, 18: 24928(P)
feasibility of heavy-water-moderated, 18: 24882(R) (DP-905)
fuel elements for, testing uranium-dioxide, 18: 24854(R) (CEND-2863-211)
hazards evaluation in STEP project, 18: 24956(R) (IDO-16961)
heat transfer in heterogeneous, transient, 18: 23776
operation of Canada-India, 18: 24949 (AEET/ROD/7)
performance of Canada-India Reactor, 18: 24948 (AEET/ROD/6)

WATER MODERATED REACTORS
control of suspension-fueled, by moderator flow rate, 18: 24842(P)
design of heavy water-moderated steam-cooled, 18: 24928(P)
hazards evaluation in STEP project, 18: 24956(R) (IDO-16961)

WATER SUPPLIES
analysis for barium-140, radium-226, and strontium-90 by ion exchange, 18: 23421

WELDING
electron-beam and vacuum arc, 18: 24108
procedures, specifications, and qualification test records for, Hanford guide for, 18: 24102 (TID-20625(Vol.I))
procedures, specifications, and qualification test records for, Hanford guide to, 18: 24103 (TID-20625(Vol.II))
procedures, specifications, and qualification test records for, Hanford guide to, 18: 24104 (TID-20625(Vol.III))

WELL LOGGING
neutron slowing down and absorption method and apparatus for, 18: 23868(P)

WHEAT
isotope effects of heavy water on physical properties of gluten in, 18: 23477
phosphorus-32 uptake by seeds of, effects on metabolism of, 18: 23205(T) (JPRS-24290(p.36-42))
radioinduced and chemically induced mutations in *Triticum durum*, 18: 23320
strontium-90 content of, from 1963 harvest, 18: 23804

WOUNDS
radiation effects on healing of, in mice, effect of homologous bone marrow and lymph node cells transplantation on, 18: 23273

X

X RADIATION
biological effects on eye lens in frogs, 18: 23268
biological effects on mice, protection against, using chlorotrianise, 18: 23371
conditioned behavior of rats induced by, 18: 23236 (FSU-2690-15 (Paper 2))
conditioned behavior of rats induced by, 18: 23237 (FSU-2690-15(Paper 3))
conditioned behavior of rats induced by, 18: 23238 (FSU-2690-15(Paper 4))
conditioned behavior of rats induced by, 18: 23239 (FSU-2690-15(Paper 5))
conditioned behavior of rats induced by, 18: 23240 (FSU-2690-15 (Paper 7))
detection and measurement using proportional counters, electronic reduction of background for, 18: 23974
dose measurements in vicinity of interface between two media of different atomic compositions exposed to, of 11 to 20 Mv, 18: 23388
dosimetry of, silicon junctions for, 18: 23967
effects of exposure of seeds to low-dose, on plant growth and development, 18: 23253(T) (OTS-61-11326)
effects of localized, on bone marrow, destruction and restoration phases in, 18: 23265
effects on *Aedes aegypti* cytogenetics, 18: 23262
effects on amino acid content in blood serum, 18: 23319
effects on beagle reproduction as affected by aging, 18: 23341
effects on biosynthesis and biotransformation of corticosteroids, 18: 23348
effects on blood serum protein content in rabbits, effect of infection on, 18: 23174
effects on bull semen of testicular, 18: 23337
effects on cerebellum development in mice, 18: 23284
effects on cerebral cortex bioelectric activity, 18: 23308
effects on course of skin infection in rabbits, 18: 23315
effects on cytoplasmic movement, 18: 23274
effects on Drosophila sperm, effects of temperature on, 18: 23279
effects on enzyme activity in rat liver, 18: 23241(R) (NP-13918(p.13-27))
effects on EPR spectra of stretched polypropylene, 18: 23679
effects on female germ cells of Drosophila, 18: 23281
effects on histology and saline-soluble DNA content in mouse spleen, 18: 23257
effects on horse bean plantules, effects of oxygen pressure on, 18: 23299
effects on incorporation of amino acids into proteins, 18: 23259
effects on lamb testes, 18: 23338
effects on metabolic and phagocytic activities of polymorphonuclear leukocytes, 18: 23242(R) (TID-20379)
effects on metastatic rate in rats injected with Guerin epithelioma, 18: 23264
effects on mice, effects of gonadectomy, sex, and strain on, 18: 23347
effects on mice, protective effects of 3-alkyl-1,3-thiazane derivatives against, 18: 23370
effects on mice, use of nicotinic acid derivative in treatment for, 18: 23365
effects on microstructure of duodenum cells, early, 18: 23266
effects on mouse aging and kidney function, 18: 23291
effects on mouse fertility, 18: 23325
effects on myosin ATPase activity, 18: 23258
effects on nerve fiber action-potential, effects of sodium azide on, 18: 23277
effects on nerve structures in dog and rabbit liver, 18: 23309
effects on neuro-endocrine system in dogs and rabbits, 18: 23377
effects on oxidative phosphorylation in rat liver mitochondria, 18: 23233(R) (ANL-6823(p.157-60))
effects on oxytocin content of rat pituitary, 18: 23275
effects on peripheral blood in rats, effects of serotonin on, 18: 23376
effects on protein in dog, 18: 23306
effects on rabbit skin, protective effects of esculin against, 18: 23372
effects on rabbits receiving cortisone treatment, 18: 23267
effects on rat hematology, 18: 23296
effects on rat thyroid growth function, method for measurement of, 18: 23260
effects on reproductive capacity, 18: 23324
effects on reproduction in beagles, 18: 23345
effects on reproduction in female hamsters, 18: 23344
effects on serum-resistant syphilis, 18: 23391
effects on sheep reproductive potential, 18: 23342
effects on sodium thiocyanate space, 18: 23285
effects on sulfur-35-labeled methionine uptake by rat blood serum,

18: 23247 (JPRS-24164(p.1-8))
effects on surface phenomena of polyacrylic acid molecules, 18: 23690
effects on toxic response of mice to dietary 2-mercaptoethylamine or *p*-aminopropiophenone, 18: 23358(R) (NP-13918(p.116-28))
effects on uptake of carbon-14-labeled methionine by rat tissue, 18: 23293
effects on urinary excretion of creatine and 2-methyl-β-alanine in rats, 18: 23234 (EUR-591.d)
effects on wound healing in mice, effect of injections of homologous bone marrow and lymph node cells on, 18: 23273
exchange between nitrogen-14 and -15 induced in gaseous nitrogen by, mechanism of, 18: 23680
excitation in coatings for thickness measurements, 18: 24046 (PAN-485/I-A)
genetic effects on chloroplasts in *Chara vulgaris* algae, 18: 23287
genetic effects on chromosomes of reproductive cells in mice, protective effects of streptomycin against, 18: 23359(T) (JPRS-24593(p.120-5))
gynogenetic effects in vertebrates, 18: 23335
leukemia induction in mice by, plasma lactic dehydrogenase activity in, 18: 23256
monitoring, 18: 23901
monochromatizing methods, 18: 24224
mutagenic effects in *Phaseolus mungo*, 18: 23263
performance for detection of shallow buried objects, 18: 23782 (NP-13943(p.117-27))
protection against, effects of cytochrome C on carbon oxide, 18: 23383
radioactivity in foods induced by, 18: 23815 (AERE-R-4601)
spectra in beta decay at 0 to 20 kev, 18: 24408
toxic effects on human lymphocytes, 18: 23294
translocations induced in Drosophila by, linear dose dependence of, 18: 23282
tumorigenic effects in mice, 18: 23231(R) (ANL-6823(p.20-43))
tumorigenic effects on rat islets, 18: 23286

X-RAY-DIFFRACTION ANALYSIS
point-by-point study of crystal surfaces by Berg-Barrett methods, 18: 25035(T) (UCRL-Trans-1055(L))

X-RAY EQUIPMENT
performance for detection of shallow buried objects, 18: 23782 (NP-13943(p.117-27))

X-RAY MONOCHROMATORS
description, 18: 24224

XANTHATES
CS_2–xanthogenate, carbon-13 enrichment and exchange in, 18: 24057(P)

XENON
alpha scattering by, excitation and ionization effects in, 18: 23972
electric discharge in, microwave resonance emission spectra of, 18: 24772
lamp for producing retinal burns, 18: 23254

XENON FLUORIDES
preparation at room temperature and high pressures, 18: 23476
spectrum of, explanation of uv, 18: 23469
spectrum of, interpretation of uv, 18: 23468

XENON IONS
reactions with nuclear emulsions, effects of energy and mass on grain darkening in, 18: 23916

XENON ISOTOPES
content in air and water of swimming pool reactor, 18: 24947 (AEET/AM/38)
separation by thermal diffusion, 18: 24050(R) (ORNL-3607)

XENON ISOTOPES Xe-131
meson (μ^-) reaction, cross sections of particle production in, 18: 24587 (JINR-P-1584)

XENON ISOTOPES Xe-133
diffusion from irradiated uranium carbides, 18: 24072(R,T) (EURAEC-934)
release from irradiated uranium carbides at 1000 to 1600°C, 18: 24988(R) (BMI-1665(Del.))
release from irradiated coated fuel particles, 18: 24988(R) (BMI-1665(Del.))

XENON ISOTOPES Xe-135
release from irradiated uranium carbides at 1000 to 1600°C, 18: 24988(R) (BMI-1665(Del.))
release from irradiated coated fuel particles, 18: 24988(R) (BMI-1665(Del.))

XYLOSE
radioinduced free radicals in, gamma, 18: 23651(T,R) (AEC-tr-6316 (p.573-86))

Y

YEASTS
enzyme purification and methionine biosynthesis in Saccharomyces, 18: 23193(R) (ANL-6823(p.128-40))
radiation effects on, protective effects of antibiotics against, 18: 23380
radiosensitivity, 18: 23311
radiosensitivity effects of phenoxazine on, 18: 23378

YTTERBIUM
polarographic behavior in tetraethylammonium bromide at dropping mercury electrode, 18: 23463
proton elastic scattering at 55 Mev, effects of nuclear deformation on, 18: 24665
separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)

YTTERBIUM ETHYL SULFATES
spin-lattice relaxation in, 18: 23528

YTTERBIUM IONS
electron paramagnetic resonance in calcium tungstates, 18: 23525
electron paramagnetic resonance in calcium fluorides, relaxation in, 18: 23526
electron paramagnetic resonance in calcium fluorides, spin-lattice relaxation in, 18: 23527

YTTERBIUM MANGANATES
magnetic properties and manganese ion moment configurations of, 18: 24128 (CONF-405-34)

YTTERBIUM OXALATES
dynamic decomposition of, effects of air, carbon dioxide, and nitrogen on, 18: 23507

YTTERBIUM OXIDES
magnetic susceptibility at 4.2 to 300°K, 18: 23513
spectra in low frequency region, infrared, 18: 23549
CeO_2–Yb_2O_3, equilibrium phase studies on, 18: 23509
Yb_2O_3–ZrO_2, crystal structure, differential thermal analysis, and thermal expansion of, 18: 23503

YTTRIUM
magnetic properties of, effects of crystalline field and structure on, 18: 24186
separation by sorption on calcium oxalate, 18: 23714
separation from strontium by sorption on gelatin foam, 18: 23735
vapor pressure of solid, at 1100 to 1480°C, 18: 24177

YTTRIUM ALLOYS
Pu–Y, phase studies, 18: 24815(R) (MLM-1184)

YTTRIUM FLUORIDES
CaF_2–YF_3, formation and structure, 18: 23533

YTTRIUM ISOTOPES Y-89
helium-3 reactions (^{3}He,d) at 22 Mev, zirconium-90 energy levels from, 18: 24663

YTTRIUM ISOTOPES Y-90
production in neon-22 and oxygen-18 reactions with thorium-232, 18: 24690
radiation dose to mouse gonads from injected, 18: 23185(R) (ANL-6823(p.76-80))
separation from strontium-90, by ion exchange, 18: 23717
tumorigenic effects in mice, 18: 23231(R) (ANL-6823(p.20-43))
used with strontium-90, bremsstrahlung efficiency in bone of, 18: 23173

YTTRIUM ISOTOPES Y-92
production in neon-22 and oxygen-18 reactions with thorium-232, 18: 24690

YTTRIUM ISOTOPES Y-93
production in neon-22 and oxygen-18 reactions with thorium-232, 18: 24690

YTTRIUM MANGANATES
magnetic properties and manganese ion moment configurations of,

18: 24128 (CONF-405-34)

YTTRIUM OXALATES
- dynamic decomposition of, effects of air, carbon dioxide, and nitrogen on, 18: 23507

YTTRIUM OXIDES
- properties as nuclear thermionic device material, 18: 24367 (GEST-2022)
- spectra in low frequency region, infrared, 18: 23549
- CeO_2–ThO_2–Y_2O_3, phase studies on, 18: 23516
- CeO_2–Y_2O_3, equilibrium phase studies on, 18: 23509
- ThO_2–UO_2–Y_2O_3, preparation and properties as internal conversion fuel material, 18: 24065(R) (GEMP-34A)
- UO_2–Y_2O_3, preparation and properties as internal conversion fuel material, 18: 24065(R) (GEMP-34A)
- UO_2–Y_2O_3–ZrO_2, preparation and properties as internal conversion fuel material, 18: 24065(R) (GEMP-34A)

YTTRIUM SYSTEMS
- C–Nb–W–Y–Zr, corrosion by potassium at 2000 to 2200°F, 18: 24091

Z

ZINC
- crystal lattice vibrational spectra, 18: 24168
- neutron scattering by, 18: 24625 (WASH-1046)
- separation by anion exchange in acid-organic solvent media, 18: 23707(R) (TID-20609)

ZINC ALLOYS
- Al–Zn, radiation effects on pre-precipitation rate in, neutron, 18: 24206
- Cd–Mg–Zn, solvent properties for praseodymium, 18: 24952(R) (ANL-6880(p.6-48))
- Li–Zn, performance in fuel cells, 18: 24355 (ANL-6802(p.53-63))
- Mn–Zn, superconductivity in, effects of s-d exchange interactions in, 18: 24555
- Tc–Zn, decomposition pressure of intermetallic compound $TcZn_6$ in, at 470 to 570°C, 18: 23488

ZINC CARBONATES
- sorptive properties for organic compounds, 18: 25032(T) (SC-T-64-618)

ZINC CHLORIDES
- electric conductivity of melts, temperature coefficients for, 18: 23456(T) (AI-Trans-46)

ZINC CHROMATES
- effects on radiation behavior of polymers, 18: 24199(T,R) (AEC-tr-6316 (p.359-67))

ZINC ISOTOPES Zn-65
- uptake by euphausiids off Oregon coast, relation to Columbia River of, 18: 23182

ZINC ISOTOPES Zn-71
- gamma spectra, 18: 24657

ZINC OXIDES
- catalytic effects on radioinduced isomerization of 2-butene, 18: 23667
- effects on radiation behavior of polymers, 18: 24199(T,R) (AEC-tr-6316 (p.359-67))
- spectra in low frequency region, infrared, 18: 23549

ZINC SULFIDES
- emission characteristics of tritium-excited, 18: 23693
- preparation, properties, and performance of silver-activated, 18: 23963
- radiation effects on excitation spectra of copper-activated and pure, fast neutron, 18: 24575
- radioinduced phase transitions in, fast neutron, 18: 23665
- spectra of neutron-irradiated, optical quenching of ESR, 18: 23664

ZIRCALOY-2
- corrosion by water, oxide film tenacity and release of retained film radioactivity in, 18: 24082 (HW-79811)
- corrosion of consolidated-powder, effects of nitrogen and oxygen on, 18: 24081 (CONF-509-1)
- corrosion resistance of preoxidized, effects of stress-relief annealing on, 18: 24081 (CONF-509-1)
- creep-rupture properties of annealed and cold-worked sheet of, at 550, 650, and 750°F, 18: 24988(R) (BMI-1665(Del.))
- hydridation studies on, 18: 24910(R) (SRO-101)
- hydrogen pickup by, in 680°F water and 750°F steam, 18: 24081 (CONF-509-1)
- radiation effects on deformation and fracture of cold-worked, 18: 24191 (HW-SA-3194)
- welding of, to assemble or seal plutonium-containing fuel elements, 18: 24100 (HW-SA-3146)

ZIRCONIUM
- alloying effects on iron–nickel alloys, 18: 24161
- chemistry of aqueous solutions of, bibliography on, 18: 23472
- corrosion by liquid potassium chloride–sodium chloride at 700, 800, and 900°C, 18: 24089
- corrosion by steam at 400°C, 18: 24150(T,R) (EURAEC-538)
- determination by precipitation with α-methoxybenzyl acetic acid, 18: 23415(T) (JPRS-24552(p.60-1))
- determination by periodate method, micro-, 18: 23420
- determination in presence of thorium by precipitation with iodo-phenylformic acid, 18: 23416(T) (JPRS-24593(p.10-12))
- economic and technological review of, 18: 24076
- effects on phase transformations in steel, 18: 24152(T,R) (EURAEC-1001)
- hydrogenation of, testing equipment and techniques for, 18: 24131(R) (EURAEC-921)
- metallurgical effects on radiation damage to niobium, 18: 24196 (PWAC-278)
- neutron resonance absorption cross sections for, computer program for calculating, 18: 24589 (KAPL-M-6131)
- neutron scattering by, optical model analysis of, 18: 24625 (WASH-1046)
- neutron slowing down in, use of Monte Carlo method for, 18: 24996(R) (NAA-SR-8888(Sect.VI))
- production of pressed products without annealing, 18: 24110
- reactions with polyacrolein, effects of pH and temperature on precipitate formation in, 18: 23542
- separation from hafnium by countercurrent extraction, 18: 23739(P)
- separation from niobium and protactinium by solvent extraction using benzoylphenylhydroxylamine, 18: 23728
- superconducting properties of, effects of high pressures on, 18: 24560

ZIRCONIUM ALLOYS
- Be–Zr, fabrication by splat cooling, 18: 24067(R) (NMI-2127)
- Mo–Nb–V–Zr, fabrication and properties of coated B-66, 18: 24068(R) (NP-13955)
- Mo–Nb–V–Zr, fabrication of extruded B-66, 18: 24093(R) (AD-424593)
- Mo–Ti–Zr, corrosion by potassium at 2000 to 2200°F, 18: 24091
- Mo–Ti–Zr, factors affecting vacuum-arc melting of, 18: 24070 (RTD-TDR-63-4089)
- Mo–Ti–Zr, performance as fuel cladding in fast reactors, 18: 24952(R) (ANL-6880(p.6-48))
- Nb–Ta–W–Zr, fabrication and properties of forged and rolled FS-85, 18: 24093(R) (AD-424593)
- Nb–W–Zr, fabrication and properties of coated D-43, 18: 24068(R) (NP-13955)
- Nb–Zr, corrosion by potassium at 2000 to 2200°F, 18: 24091
- Nb–Zr, emissivity of coated, in vacuum, 18: 24138(R) (PWA-2206 (Vol.I))
- Nb–Zr, emissivity of coated, in vacuum, 18: 24139(R) (PWA-2206 (Vol.II))
- Nb–Zr, emissivity of coated, in vacuum, 18: 24140(R) (PWA-2206 (Vol.III))
- Nb–Zr, performance as cladding for uranium carbide fuels, 18: 23817(R) (ANL-6880(p.72-8))
- Nb–Zr, performance as fuel cladding in fast reactors, 18: 24952(R) (ANL-6880(p.6-48))
- Nb–Zr, performance as cladding for uranium carbide fuels, 18: 24860(R) (UNC-5071)
- Nb–Zr, superconducting magnets of, 18: 24547
- Ni–Zr, corrosion by steam at 400°C, 18: 24150(T,R) (EURAEC-538)
- Ni–Zr, phase studies and properties of extruded, effects of annealing, quenching, and tempering on, 18: 24150(T,R) (EURAEC-538)
- Pu–U–Zr, performance as zero-power reactor fuel, 18: 24952(R) (ANL-6880(p.6-48))
- Sn–Zr, development, 18: 24077(P)
- Ti–Zr, neutron inelastic scattering in, 18: 24959 (NP-13910)
- U–Zr, disintegration in mixtures of argon and oxygen and argon and nitrogen, droplet study of, 18: 24933 (AFSWC-TDR-63-51)
- U–Zr, processing of irradiated, equipment contamination and decon-

tamination in, 18: 23705 (ORNL-TM-837)
V–Zr, corrosion by steam at 400°C, 18: 24150(T,R) (EURAEC-538)
V–Zr, phase studies and properties of extruded, effects of annealing, quenching, and tempering on, 18: 24150(T,R) (EURAEC-538)
Zr–Nb, electric and mechanical properties, 18: 24158

ZIRCONIUM BORIDES
effects on oxidation resistance of graphite, 18: 24087 (WADD-TR-61-72(Vol.XXX))

ZIRCONIUM CARBIDES
electric properties of, rigid band model for interpreting, 18: 24137 (NP-13944)
stainless steel–ZrC, compatibility with uranium carbide–zirconium carbide, 18: 24072(T,R) (EURAEC-934)
UC–ZrC, compatibility with stainless steel–zirconium carbide, 18: 24072(T,R) (EURAEC-934)
UC–ZrC, phase studies, 18: 24133 (LADC-6391)

ZIRCONIUM CHLORIDE COMPLEXES
with ethyl cyanoacetate, preparation and spectra of, 18: 23471

ZIRCONIUM ISOTOPES
energy level spacings and strength function of even-even, 18: 24625 (WASH-1046)

ZIRCONIUM ISOTOPES Zr-90
alpha inelastic scattering by, $(3^-,4^-)$ doublet energy level from, 18: 24661
energy levels of, location of 4^-, 18: 24661
energy levels of, identification of 4^-, 18: 24663
neutron resonances below 10 kev, 18: 24620(R) (ORNL-TM-874)

ZIRCONIUM ISOTOPES Zr-91
neutron resonances below 10 kev, 18: 24620(R) (ORNL-TM-874)

ZIRCONIUM ISOTOPES Zr-92
neutron resonances below 10 kev, 18: 24620(R) (ORNL-TM-874)

ZIRCONIUM ISOTOPES Zr-94
neutron resonances below 10 kev, 18: 24620(R) (ORNL-TM-874)

ZIRCONIUM ISOTOPES Zr-95
content in Swedish food, 1962, 18: 23790 (NP-13828)
radioactivity standardization in mixtures with niobium-95, 18: 24042 (AERE-R-4555)
separation by calcium phosphate–humic acid flocculation, 18: 24982

ZIRCONIUM NITRIDES
electric properties of, rigid band model for interpreting, 18: 24137 (NP-13944)

ZIRCONIUM OXIDES
fluorescence and phosphorescence of, 18: 23661(T) (UCRL-Trans-1048(L))
properties as nuclear thermionic device material, 18: 24367 (GEST-2022)
properties of crystalline, energy-band and ligand-field calculations of, 18: 24296(R) (AD-417517)
reactions with liquid bismuth, 18: 24815(R) (MLM-1184)
spectra in low frequency region, infrared, 18: 23549
thermodynamic properties of large products of, 18: 24111
CeO_2–ZrO_2, crystal structure, differential thermal analysis, and thermal expansion of, 18: 23503
Dy_2O_3–ZrO_2, crystal structure, differential thermal analysis, and thermal expansion of, 18: 23503
La_2O_3–ZrO_2, crystal structure, differential thermal analysis, and thermal expansion of, 18: 23503
Nd_2O_3–ZrO_2, crystal structure, differential thermal analysis, and thermal expansion of, 18: 23503
PuO_2–ZrO_2, preparation and properties of pellets of, 18: 24815(R) (MLM-1184)
UO_2–Y_2O_3–ZrO_2, preparation and properties as internal conversion fuel material, 18: 24065(R) (GEMP-34A)
Yb_2O_3–ZrO_2, crystal structure, differential thermal analysis, and thermal expansion of, 18: 23503
Zr–ZrO_2, thermal conductivity at 24°C, 18: 23817(R) (ANL-6880 (p.72-8))

ZIRCONIUM SYSTEMS
C–Mo–Nb–W–Zr, corrosion by potassium at 2000 to 2200°F, 18: 24091
C–Nb–W–Y–Zr, corrosion by potassium at 2000 to 2200°F, 18: 24091
O–Si–Ti–W–Zr, development for high-temperature oxidation protection of tungsten, 18: 24086(R) (NP-13898)
Zr–ZrO_2, thermal conductivity at 24°C, 18: 23817(R) (ANL-6880 (p.72-8))

ZIRFLEX PROCESS
equipment contamination and decontamination in, 18: 23705 (ORNL-TM-837)

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Reports, numbered translations, and patents abstracted during the period are included in this index. Each item is listed by report number; this is followed by the abstract number and a brief notation regarding public availability. The index entries show, when known, which reports are on file in the depository libraries, which reports have been published in open-literature journals (journal citation given), and which reports can be purchased (source and price). Whenever a report is identified by more than one number, cross references from secondary to primary report numbers are cited.

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OTS	For sale by the Clearinghouse for Federal Scientific and Technical Information, National Bureau of Standards, U. S. Department of Commerce, Springfield, Virginia.
UKAEA, London	Available from United Kingdom Atomic Energy Authority, 11 Charles II Street, London, S. W. 1.
USGS	Available free of charge from the U. S. Geological Survey, Washington, D. C. 20242.

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Report No.	Abstract No.	Availability
ACNP–	**(Misc.)**	
64022	18-23760	Dep.(mc); $3.60(fs), $1.16(mf) OTS
64517(Rev.1)	18-24873	Dep.(mc); $9.60(fs), $3.59(mf) OTS
64529	18-24874	Dep.(mc); $7.60(fs), $2.45(mf) OTS
64536	18-24875	Dep.(mc); $2.60(fs), $1.10(mf) OTS
AD–	**(Misc.)**	
414194	18-24122	See ASD-TDR-63-371
414394	18-24933	See AFSWC-TDR-63-51
417496	18-24739	$2.60(OTS)
417517	18-24296	$10.50(OTS)
418226	18-24366	See ASD-TDR-63-750
418276	18-24350	$2.60(OTS)
418388	18-24118	$7.60(OTS)
419389	18-24483	See SUI-63-21
419519	18-24365	See ASD-TDR-63-37
422980	18-24123	See ASD-TDR-63-676
423400	18-24141	See RTD-TDR-63-4102
424593	18-24093	
425148	18-24119	$4.60(OTS)
426572	18-24239	See AFOSR-J1340
426688	18-24070	See RTD-TDR-63-4089
426769	18-24740	$5.60(OTS)
426775	18-24297	See AFCRL-63-558
426779	18-24741	See AFOSR-5367
427285	18-24351	$6.60(OTS)
428117	18-23178	See HI-303-RR/A-III
430059	18-23821	See HI-303-RR
430098	18-23822	See HI-303-RR/A-IV
433784	18-23179	See HI-303-RR/A1-2
436324	18-24094	$1.10(OTS)
438709	18-23784	See NP-13956
439331	18-24582	$1.60(OTS)
AEC-tr–		
6316	18-25021	Dep.; $7.25(OTS)
6394	18-24088	Dep.(mc); $1.10(fs), $0.80(mf) JCL
AECL–	**(Canadian)**	
1898	18-24061	See TDSI-49
AED-C–	**(German)**	
21-01	18-23807	Dep.(mc)
23-01	18-24214	Dep.(mc)
AEET/AM–	**(Indian)**	
26	18-23789	Supplemented by AEET/AM/39
38	18-24947	Dep.(mc)
39	18-23789	Dep.(mc)
AEET-CD–	**(Indian)**	
21	18-24120	Dep.(mc)
AEET-ROD–	**(Indian)**	
6	18-24948	Dep.(mc)
7	18-24949	Dep.(mc)
9	18-24950	Dep.(mc)
10	18-24810	Dep.(mc)
AEEW-M–	**(British)**	
426	18-24987	Dep.
442	18-24377	Dep.; $0.30(BIS); 1s. 9d. (HMSO)
AEEW-R–	**(British)**	
180	18-23761	Dep.; $5.00(BIS); 25s. 0d. (HMSO)
201	18-24852	J. Nucl. Energy, Pt. A & B, 18: 105-24 (1964)
326	18-24378	Dep.; $0.90(BIS); 4s. 6d. (HMSO)
AERE-NP–	**(British)**	
Gen-32	18-24022	p.679-84 of "Nuclear Electronics." Paris, ENEA, 1964

Report No.	Abstract No.	Availability
AERE-R–	**(British)**	
2935	18-24187	Dep.(mc)
4084	18-23808	Dep.; $0.60(BIS); 3s. (HMSO)
4085	18-23753	Dep.; $1.80(BIS); 9s. (HMSO)
4380	18-23870	Dep.; $0.50(BIS); 2s. 6d. (HMSO)
4394	18-24021	p.667-77 of "Nuclear Electronics." Paris, ENEA, 1964
4466	18-23402	Dep.; $0.60(BIS); 3s. (HMSO)
4473	18-23991	p.243-9 of "Nuclear Electronics." Paris, ENEA, 1964
4476	18-23565	Phil. Mag. (8), 9: 545-56(1964)
4528	18-23809	Dep.; $1.80(BIS); 9s. (HMSO)
4555	18-24042	Dep.; $0.50(BIS); 2s. 6d. (HMSO)
4601	18-23815	Dep.; $0.90(BIS); 4s. 6d. (HMSO)
4608	18-23403	Dep.; $0.60(BIS); 3s. (HMSO)
4623	18-23762	Dep.; $0.50(BIS); 2s. 6d. (HMSO)
AERE-Trans–	**(British)**	
1000	18-23246	Dep.; $0.50(BIS); 2s. 6d. (HMSO)
AFCRL–	**(Non-AEC)**	
63-558	18-24297	$2.60(OTS)
AFOSR–	**(Misc.)**	
5293	18-24483	See SUI-63-21
5367	18-24741	$8.60(OTS)
J1340	18-24239	$1.10(OTS)
AFSWC-TDR–	**(Non-AEC)**	
63-51	18-24933	$8.10(OTS)
AHSB(S)–	**(British)**	
R-64	18-23816	Dep.; $1.50(BIS); 7s. 6d. (HMSO)
AI–	**(Misc.)**	
8700(Vol.I)	18-24095	Dep.(mc); $2.60(fs), $1.07(mf) OTS
8700(Vol.II)	18-24096	Dep.(mc); $3.60(fs), $1.16(mf) OTS
8700(Vol.III)	18-24097	Dep.(mc); $7.60(fs), $2.60(mf) OTS
8700(Vol.IV)	18-24098	Dep.(mc); $6.60(fs), $2.06(mf) OTS
8700(Vol.V)	18-23404	Dep.(mc); $5.60(fs), $1.82(mf) OTS
AI-Trans.–		
46	18-23456	Dep.(mc); $2.60(fs), $1.04(mf) JCL
AMP–	**(Non-AEC)**	
137	18-24756	See NP-13946
ANL–		
6654	18-23763	Dep.; $2.50(OTS)
6802	18-24352	Dep.; $2.75(OTS)
6804	18-24121	Dep.; $0.50(OTS)
6805	18-24811	Dep.; $1.50(OTS)
6822	18-23871	Dep.; $2.00(OTS)
6823	18-23161	Dep.; $3.00(OTS)
6823(p.20-43)	18-23231	Natl. Cancer Inst. Monograph, 14: 243-70(1964)
6836	18-24844	Dep.; $0.75(OTS)
6880	18-24812	Dep.; $2.00(OTS)
ANL-Trans–		
15	18-25022	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
19	18-24200	Dep.(mc); $2.60(fs), $0.95(mf) JCL
21	18-25023	Dep.(mc); $2.60(fs), $1.10(mf) JCL
22	18-24201	Dep.(mc); $2.60(fs), $1.01(mf) JCL
23	18-23457	Dep.(mc); $1.60(fs), $0.80(mf) OTS
24	18-25024	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
ANP–		
53	18-24934	Dep.(mc); $15.00(fs), $6.95(mf) OTS
APEX–		
142	18-24876	Dep.(mc); $1.60(fs), $0.80(mf) OTS

Report No.	Abstract No.	Availability
260	18-24935	Dep.(mc); $6.60(fs), $2.30(mf) OTS
329	18-24188	Dep.(mc); $1.10(fs), $0.80(mf) OTS
636	18-24936	Dep.(mc); $2.60(fs), $0.83(mf) OTS
638	18-24845	Dep.(mc); $2.60(fs), $0.98(mf) OTS
724	18-23764	$5.60(fs), $2.00(mf) OTS
730	18-24189	Dep.(mc); $2.60(fs), $0.92(mf) OTS
917	18-24937	Dep.(mc); $5.60(fs), $1.85(mf) OTS
ASD-TDR–	**(Non-AEC)**	
63-37	18-24365	$8.10(OTS)
63-371	18-24122	$1.00(OTS)
63-676	18-24123	
63-750	18-24366	$3.60(OTS)
ATR-FE–		
101	18-24963	See TID-20621
AWRE-O–	**(British)**	
93/63	18-23818	Dep.(mc)
BAW–	**(Misc.)**	
189	18-24877	
BM-RI–	**(Misc.)**	
6446	18-23435	Free(Bureau of Mines)
BMI–	**(Misc.)**	
1665(Del.)	18-24988	Dep.; $1.25(OTS)
BMI-X–		
286	18-24080	Dep.(mc); $1.60(fs), $0.80(mf) OTS
BN–	**(Misc.)**	
342	18-24753	See N64-13056
BNL–		
828	18-23199	Dep.; $0.50(OTS)
833	18-23872	Dep.; $0.75(OTS)
837(p.427-38)	18-24402	See TID-19033
854	18-23165	Dep.; $0.50(OTS)
855	18-24064	Dep.; $1.25(OTS)
7034	18-24989	Dep.(mc); $2.60(fs), $0.86(mf) OTS
7336	18-23291	Radiation Res., 22: 95-105(1964)
7468	18-24407	Ann. Phys. (N. Y.), 27: 183-92(1964)
7531	18-23296	Radiation Res., 22: 136-43(1964)
7732	18-24169	Phys. Rev., 134: A1547-53(1964)
BRL–	**(Misc.)**	
1238	18-24564	
CEA–	**(French)**	
2341	18-24124	Dep.(mc)
CEA-R–	**(French)**	
2402	18-23837	Dep.(mc)
2404	18-23698	Dep.(mc)
2406	18-23568	Dep.(mc)
2409	18-23819	Dep.(mc)
2411	18-24814	Dep.(mc)
2414	18-23436	Dep.(mc)
2415	18-23405	Dep.(mc)
2417	18-24747	Dep.(mc)
CEND–	**(Misc.)**	
2863-211	18-24854	Dep.(mc); $4.60(fs), $1.46(mf) OTS
3256-209	18-24125	Dep.(mc); $3.60(fs), $1.22(mf) OTS
CERN–	**(European Organization for Nuclear Research)**	
64-20	18-24240	Dep.(mc)
64-22	18-24241	Dep.(mc)

Report No.	Abstract No.	Availability
CF–	**(Oak Ridge National Lab.)**	
63-4-18	18-24907	See ORNL-TM-870
CLM-Bib–	**(British)**	
4	18-24748	Dep.(mc); $0.60(BIS); 3s. (HMSO)
CONF-12–	**(American Nuclear Society 8th Annual Meeting, Boston, June 1962)**	
3	18-23386	Dep.(mc); $1.60(fs), $0.80(mf) OTS; Gmelin, AED-CONF-62-105-135
CONF-22–	**(American Physical Society, 1963 Annual Meeting, New York, Jan. 1963)**	
33	18-24242	Dep.(mc); $1.10(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-007-110
CONF-38–	**(American Physical Society Division of Plasma Physics 4th Annual Meeting, Atlantic City, Nov.-Dec. 1962)**	
11	18-24750	See EUR-1627.f
CONF-46–	**(American Physical Society 1963 Spring Meeting, Washington, D. C., Apr. 1963)**	
112	18-24563	ORINS. Gmelin, AED-CONF-63-048-122
113	18-24738	ORINS. Gmelin, AED-CONF-63-048-123
CONF-62–	**18-24707**	**(Proceedings of the Third Conference on Reactions Between Complex Nuclei, Held at Asilomar (Pacific Grove, California) April 14–18, 1963. Berkeley and Los Angeles, University of California Press, 1963. $17.00)**
CONF-157–	**(American Chemical Society Northwest Regional Meeting, Bellingham, Wash., June 1963)**	
7	18-24932	See HW-SA-3018
CONF-173–	**(American Meteorological Society 44th Annual Meeting, Los Angeles, Calif., Jan. 1964)**	
5	18-24212	See HW-SA-3167
CONF-182–	**(9th Scintillation and Semiconductor Counter Symposium, Washington, D. C., Feb. 1963)**	
14	18-23865	ORINS. Gmelin, AED-CONF-64-008-1
CONF-205–	**(International Atomic Energy Agency Symposium on the Biological Effects of Neutron Irradiations, Upton, N. Y., Oct. 1963)**	
13	18-23890	See SCPRI(S)-92
CONF-243–	**(American Nuclear Society Conference on Problems of Operating Research and Power Reactors, Ottawa, Oct. 1963)**	
54	18-24949	See AEET/ROD/7
55	18-24948	See AEET/ROD/6
CONF-251	**18-24911**	**(Rotating Machinery for Gas Cooled Reactor Application, Gatlinburg, Tenn., Nov. 1963)**
CONF-322–	**(American Chemical Society Production Technology of Np-237 and Pu-238, Denver, Jan. 1964)**	
12	18-23437	Dep.(mc); $2.60(fs), $0.98(mf) OTS; Gmelin, AED-CONF-64-002-9
13	18-23515	ORINS. Gmelin, AED-CONF-64-002-13
CONF-340–	**(American Physical Society 1963 Autumn Meeting, Chicago, Oct. 1963)**	
16	18-24403	See UCRL-7563-T
CONF-369–	**(International Symposium on Nuclear Electronics, Paris, Nov. 1963)**	

Report No.	Abstract No.	Availability
4	18-23971	p.21-41 of "Nuclear Electronics." Paris, ENEA, 1964
CONF-373–	**(Technical Conference on Applied Aspects of Refractory Metals, Los Angeles, Dec. 1963)**	
11	18-24091	ORINS. Gmelin, AED-CONF-63-252-11
CONF-396–	**(Symposium on Nuclear Spectroscopy with Direct Reactions, Argonne, Ill., Feb. 1964)**	
12	18-24400	See NYO-1807-9
CONF-405–	**(4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964)**	
8	18-23505	ORINS
9	18-23504	ORINS
10	18-23507	ORINS
11	18-23503	ORINS
12	18-23514	ORINS
13	18-23516	ORINS
14	18-23517	ORINS
15	18-23508	ORINS
16	18-23506	ORINS
17	18-23510	ORINS
18	18-23509	ORINS
22	18-23518	ORINS
23	18-24182	ORINS
24	18-24183	ORINS
25	18-23513	ORINS
26	18-23512	ORINS
27	18-23511	ORINS
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29	18-24184	ORINS
32	18-24126	Dep.(mc); \$3.60(fs), \$1.16(mf) OTS
33	18-24127	Dep.(mc); \$1.60(fs), \$0.80(mf) OTS
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41	18-23442	Dep.(mc); \$1.60(fs), \$0.80(mf) OTS Phys. Rev., 134: A1620-4(1964)
42	18-23453	See UCRL-11126
CONF-414	**18-24352**	**(Conference on Direct Energy Conversion, Argonne, Ill., Nov. 1963)**
CONF-421	**18-23781**	**(Symposium on Detection of Underground Objects, Materials, and Properties, Fort Belvoir, Va., Mar. 1962)**
CONF-448–	**(IAEA Symposium of the Assessment of Radioactive Body Burdens in Man, Heidelberg, Ger., May 1964)**	
3	18-23825	See LADC-6104
CONF-469–	**(Conference on Physics of Reactors, Milan, Nov.–Dec. 1963)**	
4	18-24846	See EUR-1618.e
CONF-470–	**(3rd Plowshare Symposium on Engineering with Nuclear Explosives, Davis, Calif., Apr. 1964)**	
8	18-23752	See UCRL-7793
CONF-502–	**(International Congress of Nuclear Physics, Paris, July 1964)**	
4	18-24583	Dep.(mc); \$1.10(fs), \$0.80(mf) OTS
5	18-24393	See LADC-6357
6	18-24590	See LADC-6370
7	18-24618	See NYO-1807-8
8	18-24617	See NYO-1807-7

Report No.	Abstract No.	Availability
CONF-504–	**(American Power Conference 26th Annual Meeting, Chicago, Apr. 1964)**	
3	18-24878	Dep.(mc); \$2.60(fs), \$0.98(mf) OTS
CONF-505–	**(Society of Automotive Engineers Air Transport and Space Meeting, New York, Apr. 1964)**	
1	18-24376	ORINS
2	18-23779	ORINS
3	18-24943	ORINS
4	18-24927	ORINS
5	18-24944	ORINS
6	18-24945	ORINS
CONF-508–	**(4th Union of German Doctors for Radiation Protection, Würzburg, Germany, Oct. 1963)**	
1	18-23234	See EUR-591.d
CONF-509–	**(13th Annual Corrosion Symposium, Argonne, Ill., May 1964)**	
1	18-24081	Dep.(mc); \$5.60(fs), \$1.79(mf) OTS
2	18-24080	See BMI-X-286
CONF-510–	**(Conference on Symmetry Principles at High Energy, Coral Gables, Fla., Jan. 1964)**	
1	18-24379	Dep.(mc); \$4.60(fs), \$1.58(mf) OTS
CONF-511–	**(American Welding Society, 45th Annual Meeting, Detroit, May 1964)**	
1	18-24100	See HW-SA-3146
CONF-512–	**(American Society for Testing and Materials 67th Annual Meeting, Chicago, June 1964)**	
1	18-24192	See HW-SA-3221
2	18-24193	See HW-SA-3436
3	18-24191	See HW-SA-3194
4	18-23406	Dep.(mc); \$1.60(fs), \$0.80(mf) OTS
CONF-513–	**(Iowa Academy of Science, Decorah, Iowa, Apr. 1964)**	
1	18-24991	See IS-884
CONF-514–	**(Atomic Energy Commission Meeting on Commercial Fabrication of Plutonium Fuel, Richland, Wash., Apr. 1964)**	
1	18-23824	See HW-81363
CONF-516–	**(19th Purdue Industrial Waste Conference, Lafayette, Ind., May 1964)**	
1	18-24976	See LADC-6398
CONF-517–	**(5th Plansee Seminar-Reutte, Tyrol, Austria, June 1964)**	
1	18-24133	See LADC-6391
CONF-518–	**(The Fall Joint Computer Conference, San Francisco, Oct. 1964)**	
1	18-24992	See IS-904
CONF-519–	**(Cyclotron Conference, Williamsburg, Va., Feb. 1964)**	
1	18-24249	See UCRL-11316
CONF-521–	**(5th Space Science Symposium, Florence, May 1964)**	
1	18-24515	See UCRL-11409
2	18-24749	Dep.(mc); \$1.60(fs), \$0.80(mf) OTS
CONF-522–	**(Annual Meeting of the Aerospace Medical Association, Miami, Fla., May 1964)**	
1	18-23200	See HW-SA-3350
CONF-523–	**(IAEA Study Group Meeting on Operational Problems of Research Reactors and Their Use for Isotope Production and Activation Analysis, Manila, Dec. 1963)**	
1	18-24810	See AEET/ROD/10

Report No.	Abstract No.	Availability
2	18-24950	See AEET/ROD/9
CONF-524–	**(American Institute of Mining, Metallurgical and Petroleum Engineers Annual Meeting, New York, Feb. 1964)**	
5	18-24129	Dep.(mc); $1.60(fs), $0.80(mf) OTS; Gmelin, AED-CONF-64-006-2
CONF-527–	**(Institute of Chemical Engineers Spring Meeting of Institutions, Midland Section, Birmingham, Eng., Mar. 1964)**	
1	18: 23755	See UCRL-11157
CONF-528–	**(Nucleic Acids and Their Role in Biology, Milan, Sept. 1963)**	
1	18-25011	See TID-20348
CU–	**(Misc.)**	
9-64-Nonr-266(48)	18-25013	See TID-20612
10-64-30-1-2663	18-25013	See TID-20612
CVNA–	**(Misc.)**	
204	18-24879	Dep.(mc); $4.60(fs), $1.64(mf) OTS
D–	**(Misc.)**	
2-22437	18-24130	
DESY–	**(German)**	
64/3	18-24380	Dep.(mc)
DLCS–		
3570501	18-24880	Dep.(mc); $1.60(fs), $0.80(mf) OTS
4140301	18-24881	Dep.(mc); $1.60(fs), $0.80(mf) OTS
DM–	**(Misc.)**	
1299	18-23458	For translation see HW-tr-71
DMIC–	**(Non-AEC)**	
199	18-24099	
DP–		
876	18-23700	Dep.; $0.50(OTS)
880	18-23407	Dep.; $0.50(OTS)
905	18-24882	Dep.; $1.00(OTS)
DUBNA REPORTS	**(Russian)**	
See JINR (Russian)		
EANDC-US–	**(European-American Nuclear Data Committee)**	
50"U"	18-24625	See WASH-1046
EFINS–	**(Misc.)**	
63-14	18-24221	Am. J. Phys., 32: 200-5(1964)
EGCR–		
4	18-23820	Dep.; $2.75(OTS)
EGG-L–		
603	18-24938	Dep.(mc); $10.10(fs), $3.92(mf) OTS
ER–	**(Misc.)**	
5787	18-24085	See NASA-CR-54053
5885	18-24068	See NP-13955
EUR–	**(European Atomic Energy Community)**	
545.f	18-24747	See CEA-R-2417
591.d	18-23234	Dep.(mc)
1586.f	18-24151	See EURAEC-986
1618.e	18-24846	Dep.(mc)
1619.e	18-23569	Dep.(mc)
1627.f	18-24750	Dep.(mc)
1631.d	18-23765	Dep.(mc)
EUR-CEA–	**(European Atomic Energy Community)**	
FC-200	18-24751	Dep.(mc)
EURAEC–		
202	18-24979	Dep.(mc); $2.60(fs), $0.89(mf) OTS
300	18-24980	Dep.(mc); $3.60(fs), $1.16(mf) OTS
538	18-24150	Dep.(mc); $9.60(fs), $3.62(mf) OTS
541	18-24862	Dep.(mc); $10.10(fs), $4.07(mf) OTS
694	18-24863	Dep.(mc); $13.50(fs), $6.08(mf) OTS
770	18-24864	Dep.(mc); $7.60(fs), $2.57(mf) OTS
921	18-24131	Dep.(mc); $5.60(fs), $1.88(mf) OTS
934	18-24072	Dep.(mc); $4.60(fs), $1.43(mf) OTS
963	18-24883	Dep.(mc); $3.60(fs), $1.22(mf) OTS
986	18-24151	Dep.(mc); $1.10(fs), $0.85(mf) JCL
992	18-24865	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1001	18-24152	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1002	18-24153	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1024	18-24820	See GNEC-337
1045	18-23760	See ACNP-64022
1051	18-23780	See SWRI-1243-11
1056	18-24854	See CEND-2863-211
1073	18-24125	See CEND-3256-209
FSU–		
2690-15	18-23235	Dep.(mc); $7.60(fs), $2.45(mf) OTS
FTD-TT–	**(Non-AEC)**	
64-176	18-24301	OTS
GA–	**(Misc.)**	
4879	18-24168	Phys. Rev., 134: A1476-9(1964)
5037	18-24190	Dep.(mc); $1.60(fs), $0.80(mf) OTS
GA-tr–		
5174	18-24202	Dep.(mc); $2.60(fs), $1.01(mf) JCL
GEAP–	**(Misc.)**	
3771-12	18-24855	Dep.(mc); $6.60(fs), $2.09(mf) OTS
4419	18-24884	Dep.(mc); $9.60(fs), $3.59(mf) OTS
4430	18-24856	Dep.(mc); $2.60(fs), $0.89(mf) OTS
4431	18-23766	Dep.(mc); $1.60(fs), $0.80(mf) OTS
4488	18-24885	Dep.(mc); $8.60(fs), $2.96(mf) OTS
4565	18-24886	Dep.(mc); $8.60(fs), $2.96(mf) OTS
GEMP–	**(Misc.)**	
34A	18-24065	Dep.; $1.00(OTS)
285	18-24939	Dep.(mc); $5.60(fs), $1.73(mf) OTS
GEST–	**(Misc.)**	
2022	18-24367	
2031	18-24857	
GNEC–		
337	18-24820	Dep.(mc); $7.60(fs), $2.54(mf) OTS
HI–	**(Non-AEC)**	
303-RR	18-23821	$9.60(OTS)
303-RR/A-III	18-23178	$2.60(OTS)
303-RR/A-IV	18-23822	$2.60(OTS)
303-RR/A1-2	18-23179	$3.60(OTS)
HW–		
65268	18-23823	Dep.(mc); $4.60(fs), $1.64(mf) OTS
75374	18-24821	Dep.; $0.75(OTS)
77710	18-23443	Dep.(mc); $1.10(fs), $0.80(mf) OTS
79446	18-24847	Dep.; $0.75(OTS)
79811	18-24082	Dep.; $0.50(OTS)
80560F	18-24858	Dep.(mc); $1.60(fs), $0.80(mf) OTS
80798	18-23873	Dep.; $0.50(OTS)

Report No.	Abstract No.	Availability
80921	18-24887	Dep.; $0.50(OTS)
81196	18-24083	Dep.; $1.00(OTS)
81363	18-23824	Dep.(mc); $1.60(fs), $0.80(mf) OTS
81752	18-24131	Dep.(mc); $1.60(fs), $0.80(mf) OTS
81829	18-24975	Dep.(mc); $2.60(fs), $0.98(mf) OTS
HW-SA–		
3018	18-24932	Dep.(mc); $1.60(fs), $0.80(mf) OTS
3146	18-24100	Dep.(mc); $4.60(fs), $1.61(mf) OTS
3153	18-23221	Radiation Res., 22: 81-94(1964)
3157	18-23485	J. Phys. Chem., 68: 1190-3(1964)
3167	18-24212	Dep.(mc); $2.60(fs), $0.89(mf) OTS; Gmelin, AED-CONF-64-005-1
3194	18-24191	Dep.(mc); $3.60(fs), $1.40(mf) OTS
3221	18-24192	Dep.(mc); $3.60(fs), $1.13(mf) OTS
3342	18-23834	Science, 144: 859-60(1964)
3350	18-23200	Dep.(mc); $1.60(fs), $0.80(mf) OTS
3436	18-24193	Dep.(mc); $3.60(fs), $1.13(mf) OTS
3507	18-24888	Dep.(mc); $7.60(fs), $2.48(mf) OTS
HW-tr–		
71	18-23458	Dep.(mc); $2.60(fs), $1.07(mf) JCL
HWS–		
7170–7172	18-24102	See TID-20625(Vol.I)
7173–7177	18-24103	See TID-20625(Vol.II)
7178–8095	18-24104	See TID-20625(Vol.III)
I–	**(Misc.)**	
A2412-2	18-23827	See NYO-2539-1
IA–	**(Non-AEC)**	
870	18-24424	Nuovo Cimento (10), 32: 148-58(1964)
908	18-24441	Nuovo Cimento (10), 32: 498-9(1964)
IDO–		
16930	18-24954	Dep.; $2.50(OTS)
16931	18-24955	Dep.; $0.75(OTS)
16956	18-24584	Dep.; $0.75(OTS)
16961	18-24956	Dep.; $2.50(OTS)
16969	18-24585	Dep.; $1.00(OTS)
16976	18-24586	Dep.; $0.75(OTS)
INS-R–	**(New Zealand)**	
14	18-24043	Dep.(mc)
IS–		
674	18-24176	Trans. AIME, 230: 568-72(1964)
766	18-23483	J. Phys. Chem., 68: 1115-21(1964)
786	18-24426	Nuovo Cimento (10), 32: 180-97(1964)
842	18-24990	Dep.; $1.00(OTS)
884	18-24991	Dep.(mc); $2.60(fs), $0.83(mf) OTS
904	18-24992	Dep.(mc); $3.60(fs), $1.28(mf) OTS
ISS–	**(Italian)**	
63/42	18-24243	Dep.(mc)
64/2	18-23387	Dep.(mc)
64/4	18-24381	Dep.(mc)
JINR–	**(Russian)**	
E-1623	18-24382	Dep.(mc)
E-1646	18-24383	Dep.(mc)
P-1577	18-24384	Dep.(mc)
P-1584	18-24587	Dep.(mc)
P-1593	18-24385	Dep.(mc)
P-1595	18-24588	Dep.(mc)
P-1598	18-24386	Dep.(mc)
P-1615	18-24387	Dep.(mc)
P-1616	18-24388	Dep.(mc)
P-1617	18-24389	Dep.(mc)
P-1619	18-23874	Dep.(mc)
P-1624	18-24390	Dep.(mc)
P-1626	18-23444	Dep.(mc)
P-1629	18-24391	Dep.(mc)
P-1632	18-24392	Dep.(mc)
JPL-TR–	**(Non-AEC)**	
32-548	18-24368	
JPRS–	**(Non-AEC)**	
24164	18-23169	$1.25(OTS)
24290	18-23170	$1.75(OTS)
24521	18-24105	$1.75(OTS)
24552	18-25025	$2.25(OTS)
24590	15-24051	$0.50(OTS)
24593	18-25026	$3.00(OTS)
24633	18-24516	$5.00(OTS)
24696	18-23248	$0.50(OTS)
24704	18-23249	$0.50(OTS)
24803	18-23251	$0.50(OTS)
24817	18-23361	$0.50(OTS)
K–		
1586	18-23875	Dep.; $0.50(OTS)
1594	18-23445	Dep.; $0.50(OTS)
KAPL-M–		
6131	18-24589	Dep.(mc); $2.60(fs), $1.07(mf) OTS
6139	18-24993	Dep.(mc); $3.60(fs), $1.22(mf) OTS
6144	18-24059	Dep.(mc); $1.10(fs), $0.80(mf) OTS
6148	18-24060	Dep.(mc); $4.60(fs), $1.58(mf) OTS
6149	18-23767	Dep.(mc); $3.60(fs), $1.13(mf) OTS
KFK–	**(German)**	
180	18-23876	Dep.(mc)
KFK-tr–	**(German)**	
141	18-24767	Dep.(mc); $1.60(fs), $0.80(mf) JCL
LA–		
3006	18-23446	Dep.; $2.50(OTS)
3051	18-24565	Dep.; $2.25(OTS)
LA-tr–		
64-2	18-25027	Dep.(mc); $2.60(fs), $1.07(mf) JCL
LADC–		
5520	18-24650	Nucl. Phys., 53: 97-112(1964)
6022	18-23482	J. Phys. Chem., 68: 1048-51(1964)
6104	18-23825	Dep.(mc); $2.60(fs), $0.86(mf) OTS
6319	18-24668	Phys. Letters, 9: 327-9(1964)
6357	18-24393	Dep.(mc); $1.10(fs), $0.80(mf) OTS
6370	18-24590	Dep.(mc); $1.10(fs), $0.80(mf) OTS
6391	18-24133	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6398	18-24976	Dep.(mc); $3.60(fs), $1.25(mf) OTS
LAMS–		
2967	18-24848	Dep.; $1.00(OTS)
3065	18-24101	Dep.; $0.50(OTS)
3067	18-24349	Dep.; $1.50(OTS)
3069	18-24889	Dep.; $0.50(OTS)
LFEN–	**(Portuguese)**	
15	18-23578	Dep.(mc)
N1.11	18-23201	Dep.(mc)
LMSC–	**(Misc.)**	
4-50-62-1	18-24591	Dep.(mc); $3.60(fs), $1.22(mf) OTS
MATT–		
217	18-24752	Dep.; $1.25(OTS)

Report No.	Abstract No.	Availability
MIT–	**(Misc.)**	
2995-1	18-23768	Dep.(mc); $7.60(fs), $2.33(mf) OTS
MLM–		
1184	18-24815	Dep.; $3.60(fs), $1.37(mf) OTS
MND–	**(Misc.)**	
2531-1	18-24994	Dep.(mc); $8.60(fs), $3.05(mf) OTS
MND-M–	**(Misc.)**	
3088 & Add.1	18-24890	Dep.(mc); $8.10(fs), $2.75(mf) OTS
MSAR–	**(Misc.)**	
64-51	18-24084	Dep.(mc); $2.60(fs), $0.95(mf) OTS
N–	**(Misc.)**	
63-19632	18-24119	See AD-425148
64-11769	18-24123	See ASD-TDR-63-676
64-13056	18-24753	
64-13109	18-24093	See AD-424593
64-13197	18-24368	See JPL-TR-32-548
64-13373	18-24298	
NAA-SR–		
8888	18-24995	Dep.; $6.00(OTS)
NAA-SR-Memo–		
7743	18-24894	Dep.(mc); $2.60(fs), $0.95(mf) OTS
NASA-CR–	**(Non-AEC)**	
51	18-23754	$2.75(OTS)
54000	18-24940	
54053	18-24085	
55147	18-24753	See N64-13056
55166	18-24298	See N64-13373
55211	18-24368	See JPL-TR-32-548
NASA-TN–	**(Misc.)**	
D-2278	18-24754	$1.00(OTS)
NBS–	**(Misc.)**	
8253	18-24544	Dep.(mc); $1.10(fs), $0.80(mf) OTS
NDA–	**(Misc.)**	
14-134	18-24817	
NDL-TR–	**(Non-AEC)**	
59	18-24957	
NEVIS–	**(Misc.)**	
122	18-24394	Dep.(mc); $3.60(fs), $1.31(mf) OTS
NIRL-M–	**(British)**	
38	18-23877	
NMI–	**(Misc.)**	
1257	18-24134	Dep.(mc); $2.60(fs), $1.04(mf) OTS
2126	18-24066	Dep.(mc); $5.60(fs), $1.94(mf) OTS
2127	18-24067	Dep.(mc); $5.60(fs), $1.94(mf) OTS
2812	18-24135	Dep.(mc); $2.60(fs), $0.92(mf) OTS
NP–	**(AEC File No. for Non-AEC Reports)**	
13801	18-24269	
13802	18-24270	
13803	18-24271	
13804	18-24272	
13825	18-23579	
13828	18-23790	Dep.(mc)
13872	18-24395	Dep.(mc)
13892	18-24369	
13895	18-24755	

Report No.	Abstract No.	Availability
13898	18-24086	
13899	18-23740	
13900	18-24895	
13904	18-24904	
13905	18-24905	
13907	18-24958	Dep.(mc)
13908	18-24244	Dep.(mc)
13909	18-24136	Dep.(mc)
13910	18-24959	Dep.(mc)
13911	18-24960	Dep.(mc)
13912	18-24566	Dep.(mc)
13913	18-24592	Dep.(mc)
13914	18-24245	Dep.(mc)
13918	18-23166	
13925	18-24593	Dep.(mc)
13930	18-24567	Dep.(mc)
13931	18-24044	Dep.(mc)
13941	18-24614	
13942	18-23826	
13943	18-23781	
13944	18-24137	Dep.(mc); $2.60(fs), $1.04(mf) OTS
13946	18-24756	
13947	18-24396	Dep.(mc)
13948	18-24757	Dep.(mc)
13949	18-24758	Dep.(mc)
13950	18-24759	Dep.(mc)
13951	18-24760	Dep.(mc)
13952	18-24761	Dep.(mc)
13953	18-24300	
13954	18-24397	
13955	18-24068	
13956	18-23784	
13957	18-24069	Dep.(mc)
13959	18-24615	Dep.(mc)
13960	18-24248	Dep.(mc)
13961	18-24398	Dep.(mc)
13963	18-24850	Dep.(mc)
13964	18-24616	Dep.(mc)
13965	18-23886	Dep.(mc)
13966	18-24399	Dep.(mc)
NVO–		
162-8	18-23408	$1.60(fs), $0.80(mf) OTS
NYO–		
1807-4	18-24500	Phys. Letters, 9: 337-9(1964)
1807-7	18-24617	Dep.(mc); $1.10(fs), $0.80(mf) OTS
1807-8	18-24618	$1.10(fs), $0.80(mf) OTS
1807-9	18-24400	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2539-1	18-23827	Dep.(mc); $2.60(fs), $0.83(mf) OTS
3046-1	18-24997	$7.60(fs), $2.42(mf) OTS
10269	18-24619	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10270	18-24401	Dep.(mc); $2.60(fs), $1.04(mf) OTS
10496(Add.)	18-23791	Dep.(mc); $2.60(fs), $0.83(mf) OTS
10719	18-24906	Dep.(mc); $3.00(OTS)
ORNL–		
122	18-23461	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
3566	18-23702	Dep.; $1.75(OTS)
3582(p.95-7)	18-24444	Phys. Letters, 9: 339-41(1964)
3595	18-24998	Dep.; $9.10(fs), $3.38(mf) OTS
3602	18-23570	Dep.; $1.25(OTS)
3607	18-24050	Dep.; $0.50(OTS)
ORNL-TM–		
570	18-24851	Dep.(mc); $2.60(fs), $0.89(mf) OTS
789	18-23703	Dep.(mc); $2.60(fs), $0.86(mf) OTS
815	18-24195	Dep.(mc); $1.60(fs), $0.80(mf) OTS
827	18-24977	Dep.(mc); $2.60(fs), $0.86(mf) OTS
828	18-23704	Dep.(mc); $2.60(fs), $1.01(mf) OTS
831	18-23447	Dep.(mc); $2.60(fs), $0.95(mf) OTS

Report No.	Abstract No.	Availability
837	18-23705	Dep.(mc); $1.60(fs), $0.80(mf) OTS
851	18-24978	Dep.(mc); $1.60(fs), $0.80(mf) OTS
860	18-23571	Dep.(mc); $1.10(fs), $0.80(mf) OTS
870	18-24907	Dep.(mc); $4.60(fs), $1.43(mf) OTS
874	18-24620	Dep.(mc); $1.60(fs), $0.80(mf) OTS
ORNL-tr–		
68	18-24052	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
69	18-24053	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
72	18-25028	Dep.(mc); $2.60(fs), $0.92(mf) JCL
82	18-24919	Dep.(mc); $2.60(fs), $1.10(mf) JCL
84	18-23252	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
92	18-25029	Dep.(mc); $1.10(fs), $0.80(mf) JCL Colloq. Intern. Centre Natl. Rech. Sci. (Paris), No. 113: 125-8(1962)
120	18-25030	Dep.(mc); $2.60(fs), $1.07(mf) JCL
134	18-24054	Dep.(mc); $3.60(fs), $1.22(mf) JCL
OTS–	**(Misc.)**	
61-11326	18-23253	$0.50(OTS)
64-31065	18-23169	See JPRS-24164
64-31122	18-23170	See JPRS-24290
64-31229	18-24105	See JPRS-24521
64-31241	18-25025	See JPRS-24552
64-31254	18-24051	See JPRS-24590
64-31257	18-25026	See JPRS-24593
64-31275	18-24516	See JPRS-24633
64-31299	18-23248	See JPRS-24696
64-31304	18-23249	See JPRS-24704
64-31349	18-23251	See JPRS-24803
64-31356	18-23361	See JPRS-24817
PAN–	**(Polish)**	
449/VII	18-24621	Dep.
466/V	18-23448	Dep.
474/VI	18-23887	Dep.
479/I	18-23839	Dep.
485/I-A	18-24046	Dep.
488/XVII	18-23580	Dep.
491/V	18-23449	Dep.
PATENTS	**(British)**	**3s. 6d. each, U. K. Patent Office**
955,793	18-24829	
955,844	18-24830	
956,083	18-24113	
956,112	18-24048	
956,120	18-24037	
956,225	18-24831	
956,238	18-24038	
956,278	18-23737	
956,282	18-23519	
956,342	18-24114	
956,530	18-24868	
956,555	18-24039	
956,727	18-23866	
956,769	18-24832	
956,851	18-24869	
956,861	18-24833	
956,862	18-24928	
956,915	18-24092	
956,918	18-24834	
957,306	18-23757	
957,313	18-23520	
957,342	18-24267	
957,343	18-24835	
957,352	18-24870	
957,354	18-24115	
957,472	18-23867	
957,605	18-24116	
957,623	18-24836	
957,624	18-24837	

Report No.	Abstract No.	Availability
PATENTS	**(East German)**	
25,135	18-24057	
PATENTS	**(German)**	
1,161,361	18-24946	
1,161,649	18-24040	
1,161,694	18-24077	
1,162,004	18-24838	
1,162,005	18-24804	
1,162,007	18-24839	
1,162,008	18-24840	
1,162,576	18-24078	
1,162,694	18-24809	
1,162,695	18-23835	
1,162,819	18-23738	
1,163,465	18-24929	
1,163,991	18-24930	
1,166,391	18-24853	
1,166,945	18-24841	
1,167,991	18-24931	
1,168,577	18-24842	
PATENTS	**(U. S.)**	
3,132,077	18-24871	
3,132,192	18-23836	
3,132,198	18-23758	
3,132,247	18-24047	
3,132,924	18-23521	
3,132,966	18-23400	
3,132,979	18-24117	
3,132,998	18-24843	
3,132,999	18-24819	
3,133,000	18-24872	
3,133,195	18-23868	
3,133,196	18-24049	
3,133,197	18-23759	
3,133,227	18-24268	
3,133,243	18-23869	
3,133,793	18-24058	
3,133,794	18-23739	
3,133,887	18-24079	
3,134,018	18-24041	
PG-Report–	**(British)**	
577	18-23785	Dep.; $1.00(BIS); 5s. (HMSO)
578	18-23180	Dep.; $1.20(BIS); 6s. (HMSO)
PUC–		
1963-126	18-24622	Dep.(mc); $14.00(fs), $6.29(mf) OTS
PWA–	**(Non-AEC)**	
2206(Vol.I)	18-24138	
2206(Vol.II)	18-24139	
2206(Vol.III)	18-24140	
2337	18-24370	
PWAC–	**(Misc.)**	
278	18-24196	Dep.(mc); $2.60(fs), $0.86(mf) OTS
412	18-24908	Dep.; $1.00(OTS)
416	18-24909	Dep.; $2.25(OTS)
424	18-23888	Dep.; $1.25(OTS)
427	18-24822	Dep.; $1.50(OTS)
R–	**(Misc.)**	
173-2	18-24300	See NP-13953
2021	18-24979	For translation see EURAEC-202
2113	18-24980	For translation see EURAEC-300
RFP–		
349	18-23706	Dep.(mc); $1.10(fs), $0.80(mf) OTS

Report No.	Abstract No.	Availability
RM–	**(Misc.)**	
3908-PR	18-24371	Dep.(mc); $12.50(fs), $5.54(mf) OTS
3953-AEC	18-24999	Dep.(mc); $1.60(fs), $0.80(mf) OTS
4093-PR	18-24215	
RPI–	**(Misc.)**	
328-6	18-24571	Dep.(mc); $5.60(fs), $1.73(mf) OTS
1999-3	18-25000	Dep.(mc); $1.60(fs), $0.80(mf) OTS
RSIC–	**(Non-AEC)**	
174	18-24154	OTS
RT-CHI–	**(Italian)**	
(63)-31	18-23409	Dep.(mc)
RT-EL–	**(Italian)**	
(64)-1	18-23889	Dep.(mc)
RT-ING–	**(Italian)**	
(63)-25	18-24962	Dep.(mc)
(64)-2	18-23840	Dep.(mc)
RTD-TDR–	**(Non-AEC)**	
63-4089	18-24070	$0.75(OTS)
63-4102	18-24141	
SC-DC–		
64-459	18-25001	Dep.(mc); $2.69(fs), $1.04(mf) OTS
SC-RR–		
64-501	18-24941	Dep.; $1.75(OTS)
SC-T–		
64-616	18-23462	Dep.(mc); $1.10(fs), $0.80(mf) JCL
64-617	18-25031	Dep.(mc); $1.10(fs), $0.80(mf) JCL
64-618	18-25032	Dep.(mc); $1.60(fs), $0.80(mf) JCL
64-901	18-25033	Dep.(mc); $2.60(fs), $0.92(mf) JCL
64-902	18-25034	Dep.(mc); $1.10(fs), $0.80(mf) JCL
64-903	18-24107	Dep.(mc); $2.60(fs), $0.83(mf) JCL
SC-TM–		
64-8	18-25002	Dep.(mc); $1.60(fs), $0.80(mf) OTS
SCPRI(S)–	**(French)**	
92	18-23890	Dep.(mc)
SLAC-PUB–		
24	18-24451	Phys. Rev., 134: B1052-7(1964)
SRO–		
101	18-24910	Dep.(mc); $1.10(fs), $0.80(mf) OTS
STI-DOC–	**(International Atomic Energy Agency)**	
10/25	18-25003	Dep.(mc); $1.00; Sch 21,-; 6s.stg; F.fr.4,-; DM 3,20(IAEA)
SUI–	**(Misc.)**	
63-21	18-24483	$4.60(OTS)
SWRI–		
1243-11	18-23780	Dep.(mc); $5.60(fs), $1.76(mf) OTS
TDSI–	**(Canadian)**	
49	18-24061	Dep.; $1.50(AECL)
TID–		
4043(Rev.1)	18-25005	Dep.; Free(DTI Extension)
7015(Suppl.6)	18-23410	Dep.; $5.00(OTS)
7690	18-24911	Dep.; $4.50(OTS)
18927	18-25006	Dep.(mc); $2.60(fs), $0.83(mf) OTS
18929	18-25007	Dep.(mc); $1.60(fs), $0.80(mf) OTS
19032	18-25008	$2.60(fs), $0.89(mf) OTS
19033	18-24402	Dep.(mc); $1.60(fs), $0.80(mf) OTS
19075	18-23769	Dep.(mc); $1.60(fs), $0.80(mf) OTS
19079	18-25009	$3.60(fs), $1.25(mf) OTS
19257	18-25010	Dep.(mc); $1.10(fs), $0.80(mf) OTS
19745	18-24647	Nucl. Phys., 53: 65-76(1964)
19794	18-23286	Proc. Soc. Expti. Biol. Med., 115: 910-12 (1964)
20164	18-24874	Phys. Rev., 134: B1010-21(1964)
20183	18-23841	Dep.; $2.00(OTS)
20252	18-23450	Dep.(mc); $2.60(fs), $0.92(mf) OTS
20348	18-25011	Dep.(mc); $3.60(fs), $1.16(mf) OTS
20379	18-23242	Dep.(mc); $1.60(fs), $0.80(mf) OTS
20575	18-24372	Dep.(mc); $7.60(fs), $2.54(mf) OTS
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